VOL. 30, No. 5. September, 1923

THE PSYCHOLOGICAL REVIEW

THE BEHAVIORISTIC INTERPRETATION OF CONSCIOUSNESS II

BY K. S. LASHLEY

University of Minnesota

IV. The Behavioristic Solution

Restatement of the Problem

The problem which confronts the behaviorist is to find in the physical world deterministic relations between non-qualitative, discrete entities in time and space which fulfill certain conditions of relationship laid down by subjective evidence. I will restate these conditions briefly as the behavioristic problem.

1. Awareness, on subjective evidence, is merely a relation of something to something else, such that the attributes of content result. It presents no positive characteristics in itself and will be adequately accounted for by any physical process which will account for the attributes of content.

2. The unity of consciousness. This consists of a coëxistence of things (elements of content) in an undefinable relationship which excludes other things. Any physical system which gives rise to other attributes of content will meet this condition.

3. Sensory quality. This was found to be definable only as the indivisibility of something (element of content) in relation to something else (introspection). Any physical complex which behaves as a unit in relation to another physical process meets this condition.

4. The self-transcendence of content. This was found to

be only the fact that two elements can combine to condition the appearance of a third.

5. Determination of sequences. This reduced to the fact that one element follows another. The 'how' is not given to introspection.

6. Transcendence of time and space. This was shown to be a false deduction from the confusion of a postulated reality with the actual content of consciousness, which is a varying emotional quality. Behaviorism need only account for the origin of particular qualities, and the determination by these of particular sequences of content.

7. Self-consciousness. This turned out to be persistent sensory content capable, under certain conditions, of leading to behavior or ideational expressions of 'self,' 'I,' 'mine,' etc., with their behavior consequences.

8. Self-ordering of content. This order is as inherent in our conceptions of the material world as in consciousness, and irrelevant to the argument.

9. The creative action of consciousness. This resolved into processes whose manner of action is indefinable from introspection; processes which must be inferred in terms similar to those employed by the behaviorist in describing problem-solving; tension, trial and error, conflict, and resolution of tension.

We do not know enough of organic behavior to be able to say just how bodily mechanisms do bring about the details of behavior, but we are able to make rather probable guesses as to what is going on at any given time, and to outline roughly the kind of mechanisms that control activity.

The Conscious Machine

Let us assume that we have constructed a machine which can perform all of the neuroglandular and muscular activities of a man; a machine constructed on reflex principles, whose parts are capable of summation, facilitation, and inhibition of activity, which can react to mechanical forces on its periphery and in its interior, so that it may respond both to external stimulation, and to its own activities. Let us be sure that

we have not inadvertantly introduced any atom of psychic stuff: that the machine is not, by definition, conscious. Will its activities meet the subjective definition of consciousness, or will it remain 'merely a machine'?

Suppose that we stimulate the machine with light of wave-length = 6800 Å. The 450 trillions of vibrations per second will be summated by the chemical mechanism of the retina, and result in neural impulses of a given frequency and intensity. These will summate in turn to produce muscular movements. The pupils will contract, the eyes will converge in relation to the direction of the light beam, visceral activities will follow and finally the vocal mechanism may be thrown into activity. The machine will say, 'I see a red light.' If next we stimulate it with wave-length = 5200 Å., a different series of reactions will occur, also involving summation, and the machine will say, 'I see a green light.' If now we ask the machine to describe the color, our request will reinforce its reactions to its own reactions and we will obtain a series of internally aroused movements. But these reactions will not be to the individual elements of the previous reaction, but only to their patterns, by the process of summation. The machine cannot respond to the contraction of its pupils alone, nor to the activity of a single gland or muscle. But all these reactions, by summation, modify and condition the next response. The reaction to 6800 Å. would in turn arouse one further series of reactions, that to 5200 Å. another series. The machine can not react to the individual elements of the stimulus, but only to the two complexes of stimuli as unanalyzably different.

Now this situation fulfills all of the subjectively definable requirements for qualitative diversity (and for quality as a thing-in-itself.) Each stimulus, by summation, is unitary for subsequent reaction and therefore presents for that subsequent reaction an irreducible element. We have seen that the only possible subjective definition of quality is indescribable diversity from something else, (3, in list on page 329) and that quality as a thing-in-itself is indistinguishable from this. Our account of quality in the behavior of the machine

therefore leaves over no unexplained residue of psychic stuff, no conscious attribute.

But this attribute of indivisibility by something else is likewise in the relation of the knife to the loaf. Something more is required for our account of consciousness. And this is an account of the structure of content. It is not alone the attributes of the elements of content but the particular variety and pattern of them that makes up the supposed uniqueness of human consciousness.

To return to our machine. Its reactions are organized at several levels of complexity; that is, some stimuli call out movements in only one or a few parts, others throw the whole machine into activity. Suppose we set the machine to reading a book and to giving us a verbal report of the contents. This activity will involve the visual, gestural, vocal, and a goodly part of the intraorganic mechanisms, resulting in a complex organization of interacting parts. If now we stimulate the case of the machine lightly with a brush, a limb may be thrown into activity and scratch the stimulated area. The stimulus is adequate to excite this movement but its effects do not spread to involve in any way the vocal, gestural, or visceral mechanisms. The reflex reaction remains outside of the dominant system.[1] If, now, we apply a more intense stimulus to the case of the machine—if we pierce it with a pin, we arouse a more widespread reaction. The vocal mechanisms are involved, the machine says 'ouch!' the eyes are directed from the book and turned to the point of stimulation, the gestural mechanisms come into play, the reactions to the book are disturbed, and reactions to the pin now dominate the greater number and variety of parts of the machine. The content of the dominant system is now almost completely altered; the effects of the pin-prick have become a part of it.

[1] By 'dominant system' I mean to imply nothing more than the organized system which at the moment is most closely integrated with the speech and gestural mechanisms. That two or perhaps more such systems may be activated simultaneously is suggested by the facts of automatic writing, and the like. The confusion of tongues which might result on the motor or laryngeal theory of consciousness from such simultaneous activity, is avoided by the postulation of central chains of neural activity which activate efferent neurones only when the latter are facilitated by tonic innervation.

The subsequent activities of the mechanisms included in this dominant integration are in part determined by this pattern. New mechanisms become involved in the pattern and others drop out. The total content of the system determines the speech and gestural reactions of succeeding moments, and these in turn modify the organization of the system. A continuous flow of interrelated activities is thus produced. Reinforcement of any mechanism within the system will lend to it a greater influence upon the subsequent activities of the whole and tend to bring in other reactions associated with it.

These complexities of organization meet the subjective definition of the limits of consciousness, as a system including some and excluding other existents (2). The subjective systems have already wrecked upon this rock, and we have such self-contradictory expressions as co-conscious, foreconscious, subconscious, and unconscious mind. These are assumed to have all the attributes of consciousness except that of being known. They involve, as do the atomistic theories, the self-contradictory conception of unconscious consciousness. For this, the behaviorist may substitute the conception of systems of varying degrees of complexity, from the isolated reflex, to the activation of the entire mechanism, thus meeting the subjective definition of the limitation of consciousness: a field of varying complexity, from which some existents are excluded.[1]

The machine is capable of reacting to its own reactions.[2] Suppose that we confront it with the neurological problem described above, and study the specific instances of the working out of the relation of the frontal lobes and attention.

The request for a solution induces a set which keeps the

[1] The various attempts to correlate the presence of consciousness with a particular degree of synaptic resistance (30), with meeting of new situations (1), with associative memory (17), with conflict in response, and similar specific types of behavior have met with rather dismal failure. I believe that this conception of consciousness as the complex sequence of reactions, with the dominance of the language mechanisms, comes nearer to meeting the subjective description, than does any of the other physiological theories.

[2] The weight of evidence seems definitely against the hypothesis which makes every reaction take motor expression at once and looks upon thought as a succession of complete reflexes. The evidence offers some difficulty to the extreme methodological behaviorism, but is of little significance to the theory presented here.

mechanism active, and reinforces the habit-traces of certain systems of response-habits formed to the words 'frontal lobes,' 'learning,' 'brain lesion,' etc. 'Frontal lobes' and 'learning' have common habit elements with 'attention,' formed by reading Pillsbury's book. Reinforcing each other, they combine to arouse the verbal response, 'attention.'

This situation fulfills the subjective definition of self-transcendence of content (4), the conditioning of an element by two preceding. The determination of sequence is also met by the physiological determination.

The word 'attention' arouses the further word, 'Pillsbury,' with tension of the muscles of the arms and eyes. If we interrupt the machine's activity at this moment by asking the meaning of the last word, the reinforcement from the just preceding tensions of language mechanisms and arms, "I was thinking that off there (overt movements of hands corresponding to previous muscular tension) is the book." Here is meaning, and transcendence of time and space, in so far as they are subjectively discoverable (6).

Throughout all the reactions of the machine there persist certain common elements. Whatever the peripheral excitation to activities of the dominant system, certain constant elements of stimulation—visual from the body itself, organic from the movements of the heart, enteron, reproductive tract, etc.—will be present, modifying the dominant reaction. Further, at any time when they are reinforced so as to become effective for verbal-motor or gestural activity, they will lead to constant reactions, typified by the statement, 'This is I.' They will be unanalyzable by subsequent reaction into individual stimuli and will therefore have quality, will be the 'sensations of self' (7).

We have interrupted the machine in the midst of solving a problem. It had reached the word 'attention.' The machine has certain organizations of response which we may characterize, for brevity, as leaning forward or backward. With the first is associated the words 'yes,' 'present,' 'existent,' and the like (similarity of reaction to them constituting the likeness), making up a system of positive reaction. The second

is associated with 'no,' 'absent,' etc., making up the complex of negative reaction. Since the machine cannot simultaneously perform both movements, the systems are incompatible. These systems determine the next step in the attack of the problem. 'Attention-learning,' with forward movement. 'No attention'—backward movement—'*no* learning.' The remaining associations traced above follow by the same mechanisms until the traces of bodily reaction to 'no frontal lobes,' and 'learning present' bring about a simultaneous stimulus to conflicting movements, with a blocking of reactions.[1]

The machine has further a system of habits which tend, when aroused, to dominate its reactions. It pricks up its ears and relaxes its internal workings and gives the positive reaction at the word 'mechanism,' as it tenses and clinches its fists and straightens at the word 'vitalism,' or its associations. Further reactions, in the set of problem-solving, lead to a series of reactions which have many associations with 'mechanism.' The system presents, for a time, stimuli to no conflicting movements, and the relaxing effects of the associations with 'mechanism' gradually inhibit the tension of the set to problem solving. The solution of the problem has been reached.[2]

This is all highly speculative and by no means a true picture of the organic processes involved in human problem-

[1] This of course is an almost ludicrously simple analysis of the behavior summed up in the conceptions of positive and negative reaction. An understanding of the mutual inhibitions and facilitations of complex neural integrations will be necessary before an adequate statement of the nature of logical contradiction can be given. The above description however presents a conceivable mechanism for logical incongruity, which is all that is required for the present argument.

[2] The physiology of dynamic mechanisms in behavior is by no means worked out. In some cases, as in thirst, persistent peripheral stimulation is obviously the dominant factor in maintaining activity. In the majority of human activities the motivating mechanisms are more obscure. I have discussed the activities of the machine chiefly in terms of the reflex theory. Recent neurological evidence however indicates a much closer integration of reaction systems than is possible on the assumption of isolated reflexes. There may be special mechanisms for the maintenance of tonic integration (Lashley, '22) and it is not improbable that a common tonic innervation underlies the organization of mechanisms in the dominant system. In order that an overt reaction should occur, its mechanisms must first be primed by tonic innervation, and this may constitute the 'set' of the behaviorist.

solving, but it meets the subjectively definable requirements for determining tendency, comparison of elements of content, incompatibility of elements, blocking of the train of thought by conflict, and the final solution of the first tension (9).

We have seen that awareness is defined only by the attributes of content and the reactions of our machine have all of the subjectively definable attributes of content (1). The reactions are awareness.[1] The complexes of reaction meet the subjective description of the organization of consciousness, and leave over no undescribed psychic elements. We must conclude, therefore, that our machine is, by virtue of its organization, fully conscious. An adequate account of its behavior will constitute as complete a description of the content and processes of consciousness as can be given from introspective data. Nay, it is far more complete, for it not only describes the complexes which constitute the elements of content, but also describes the component parts of those complexes. Introspection can only describe the external form of the cloud; behaviorism may describe the constituent molecules of water vapor, their movements and patterns. In so doing, it also defines the external form of the cloud, but this dwindles to minor importance; only one of many characters of the aggregation.

V. Non-experiential Arguments

Against every system of materialistic or objective psychology there has been urged the objection that it leaves over some elements or attributes of consciousness which are not adequately accounted for by its formulations. In the foregoing pages I have attempted to analyze such of these attributes as have been clearly expressed as data of experience in the subjective literature and to show that they do not necessitate an abandonment of the behavioristic point of view. But there remain certain other attributes and other points of view which are not so directly open to attack on the basis of experiential evidence.

[1] Cf. Frost (10).

The 'Ineffable' Character of Consciousness

It may be urged that analysis of the attributes of consciousness is based upon the verbally expressible characters and that it thereby misses the very essence of consciousness, which is its impossibility of verbal characterization; that consciousness is pure experience, has no analogies, and is incapable of analysis. The behavioristic account fails because it gives no suggestion of this esoteric quality.

It is clear that subjective psychology can give no reason for its inability to express such supposedly ineffable traits of consciousness. It cannot tell in what way they are different from material things and can only affirm the distinctness by an act of faith, based, perhaps, upon the claim to a direct knowledge of the difference. I am without the pale. I can find nothing in my own experience which seems omitted from my verbal characterization. Consciousness therefore either lacks these inexpressible elements or I am not conscious and present in real life the "paradox of the thinking behaviorist" to the confusion of Lovejoy's arguments (18). I will grant either conclusion and support my thesis. But it is more pertinent to point out that, if language cannot characterize the ineffable qualities of consciousness, then a subjective science or philosophy of consciousness is impossible and the behaviorist account is as adequate as any other which may be formulated.

The 'Two-aspect' Doctrine versus Behaviorism

The parallelist may say, "After all, you have but reëxpressed the two-aspect doctrine. You have first described consciousness from within, then from without. Is it surprising that you have found a point-for-point correspondence? And does not the fact that you have given two such descriptions prove that there are two such distinct aspects?"

I am exceedingly astigmatic. To my uncorrected vision the moon appears as seven dim and overlapping moons. Now I might construct an account of the world in terms of my astigmatism. It would differ in many ways from an account written by a normal man. It would be true and real for me, but it would omit many details observed by the normal man

and would add nothing to his account which he could not predict from the optical principles underlying astigmatism. To the normal man it would be of interest only as an account of the effects of astigmatism. And as soon as I obtain adequate correction, my former account becomes for me also only a pathology of the eye.

The parallel holds for introspection and behaviorism. The subjective view is a partial and distorted analysis. Behaviorism presents the possibility of a more nearly complete analysis of the same data. It presents, therefore, a more nearly adequate solution of the problem and relegates introspection (except as the method of verbal reaction) to a subordinate place as an example of the pathology of scientific method. The subjective and objective descriptions are not descriptions from two essentially different points of view, or descriptions of two different aspects, but simply descriptions of the same thing with different degrees of accuracy and detail.

The basic assumption of the two-aspect and parallelistic doctrines is that a descriptive and analytic account of the content of consciousness can be given without reference to a physical world and that such an account will have value in itself. If the behavioristic interpretation is correct, such an account must deal wholly with systems of a high order of complexity, which are incapable of analysis by introspection but which may be analyzed by objective methods. Moreover, the account must be confined to actual content and cannot include the phenomena of the so-called subconscious. The introspectionist is in the position of describing the form and pattern of clouds which are capable of analysis into aggregates of water particles by other methods. What function can such a study serve?

We have seen that it does not reveal any different kind of stuff from that with which behaviorism deals and that it can claim only to study the same material by a different and less analytical method. One might study the form of clouds for their artistic value, as does the painter. This is avowedly not the purpose of the introspective psychologist. One may describe clouds as a recreation, in day dreaming, but surely

this is not the object of introspection. One may seek to correlate cloud forms with meteorological conditions; to explain or predict the weather by antecedent cloud pictures. This is a scientific procedure but we should have small respect for the meteorologist who confined his studies to this one aspect of his material, and excluded analysis of the structure of the cloud from the science of meteorology. Understanding of precipitation demands analysis of the cloud and a statement of the laws of condensation, of the interplay of temperature, water vapor, atmospheric dust, and air currents, elements which are not defined by cloud form. Behaviorism cannot object to such efforts at correlation, but it may point out the narrow limitations of the subjective method and its futility as an attempt to arrive at a complete understanding of the phenomena of consciousness. So long as human investigation was confined to the external form of the cloud, Jupiter Pluvius reigned in the heavens, as does the 'mind' in psychology.

VI. Lack of a Subjective Criterion of Consciousness

It is usually taken for granted in discussions of the nature of consciousness that one can at least determine the existence of consciousness by introspection or by some direct knowledge of the state and in the foregoing discussion I have admitted the assumption in order to deal with the claims for the uniqueness of consciousness. But a further examination of the evidence seems to throw doubt upon this fundamental assumption of the subjectivists. The criterion of knowing is the object known and there may be as many kinds of awareness as there are patterns of content. There is no subjective reason for holding that the process of knowing is ever twice the same. It is relatively easy to set limiting cases, to say that consciousness is typified by my condition during introspection and unconsciousness by dreamless sleep, but it is not possible to say that either of these is more like an hypnoidal state than the other. The question where consciousness appears during a gradual awakening is not less erudite than the question of when the soul enters the body of the fetus.

There are borderline states which cannot be studied by introspection for the simple reason that the slightest effort necessary for subjective examination destroys them. And below them are even vaguer states, with amnesias, which so nearly border upon the unconscious as to seem to have no definite distinguishing features.

This difficulty of introspection is well emphasized by the current patter of abnormal psychology. The various doctrines of co-, fore-, pre-, sub-, etc.- conscious states show a complete abandonment of 'knowing' as the distinguishing feature of mind and a perfect willingness to accept the paradox of consciousness without knowledge, rather than to face the problem of a subjective criterion of consciousness. Nor does such a difficulty appear only in the writings of psychopathologists. It is evident in the many atomistic theories of consciousness. We find McDougall (**20**) rejecting awareness as the distinguishing feature of mind and substituting for it an unconscious soul as the subjective element in the mind-body problem.

All this seems to point to the conclusion that there is no reliable subjective criterion of consciousness. All that introspection can do is to describe contents of varying complexity and assert that consciousness ends somewhere near the place where content becomes so vague and obscure that subsequent thought about it is impossible. Objective psychology provides an equally definite or *equally indefinite* criterion of consciousness. It describes systems of varying complexity, from the simple reflex, arousing no subsequent reactions, to the most complex chains of language and gestural activities. It can point out which of these systems is capable of arousing further activity, which is sufficiently well integrated to permit of verbal or gestural characterization, and in so doing it will have told as much as does the subjective statement that consciousness is or is not present.

For, after all, when I say that I am conscious of something, I say merely that there exist certain organizations of entities which are called by the introspectionists 'sensations, images, ideas'—describable patterns, the elements of which are inde-

scribable. The behaviorist says precisely the same thing when he describes the organization of behavior in terms of the interplay of reaction-systems which are unitary in their relations to subsequent activity. But for the purposes of science the arbitrary emphasis upon this particular kind of organization, the restriction of psychology to the study of 'conscious phenomena,' has no value and only hampers the development of physiological explanation. In modern psychology, with its hierarchies of the subconscious, the dividing line between conscious and unconscious has ceased to be of importance, relative to the dynamic features pervading both. And for behaviorism the distinction between activities which come to verbal characterization and other reactions is merely on a level with the distinction between spinal reflex and postural tonus.

VII. Consciousness as Physical Organization

The conception of consciousness here advanced is, then, that of a complex integration and succession of bodily activities which are closely related to or involve the verbal and gestural mechanisms and hence most frequently come to social expression. The elements of content are the processes of reaction to stimulation and do not differ in essential mechanism from the spinal reflex of the decapitated animal to the most complex adaptive activity of man. The objects of awareness are the physical stimuli, but in every case they act by a process of summation in such a way that the logically discrete physical elements (physicochemical processes) can not be reacted to separately and hence individually never become objects of awareness. The objects are always unanalyzable complexes specific for each reaction; hence the failure of introspection to reveal molecular vibrations etc. and the origin of sensory quality.

Such isolated reactions are not in themselves conscious or known. Consciousness consists of particular patterns and sequences of the reactions interacting among themselves and the attributes of consciousness are definable in terms of the relations and successions of the reactions. The patterns of

reaction may exist in varying degrees of complexity and continuity. As the complexity and continuity of the processes increase from simple spinal coördination to complex cerebral integrations the sum of integrated activity takes on more and more of the 'conscious attributes' of the normal waking individual. In the series of increasing complexity there are no sharp breaks, as there is no clear distinction between the subjectivist's divisions of conscious and subconscious. The 'states of consciousness' are patterns of response and their character is defined by the statement of the specific integrations concerned.

Some processes may be physiologically isolated from the principal integrated system. If they lack complexity or some continuity, they lack the essential character of 'conscious states' and are classed as reflex or automatic actions. If they are complex, long continued, and capable of influencing some of the verbo-gestural mechanisms, they may present some or all of the characters of fully integrated reactions and appear as automatic writing, somnambulism, or the like. They may even reach such complexity of integration as to equal that of the dominant system and constitute a secondary 'consciousness.'

The relation of any integration to the speech and gestural mechanisms is of prime importance for its 'conscious aspects.' Not only is the single certain evidence of consciousness in another person the existence of consistent, rational expressive movements, but the introspective evidence that there was consciousness at a given moment consists in the occurrence of thoughts (verbal or gestural sequences) conditioned by the state at that moment. The core of the 'conscious' integration is the verbo-gestural coördination.

The behaviorist has been content to limit his accounts of behavior to the simple reflex hypothesis. Neurological evidence however indicates that the complexity of integration may greatly exceed that permitted by simple reflex theory. I have elsewhere (16) sketched an hypothesis of an all-pervading substratum of postural tone upon which are superimposed reflex and voluntary movements. The evidence for

such a substratum throws some light upon the problems of 'set,' 'attention,' 'drive,' and dynamic mechanisms in general, and suggests that what I have called the dominant organization may consist of such a postural pattern with the adaptive reactions facilitated by it.

Consciousness is a general term applied to a variety of such complex integrations as I have sketched above. It marks off no group of phenomena which can be sharply defined or which have any characters requiring special scientific treatment. The distinction is made wholly on the basis of an indefinite complexity, and psychology is finding such distinctions of questionable value (witness the recent attacks upon the concept of instinct). For the behaviorist the setting off of these particular integrations from others is unimportant. The physiological mechanisms seem to form a continuous series and their analysis is hampered, not facilitated, by such artificial distinctions. 'Conscious states' have outlived their usefulness to science and with Watson we may say that, "the behaviorist does not concern himself with them because as the stream of his science broadens and deepens such older concepts are sucked under, never to reappear."

VIII. Science and Sentimentalism in Psychology

The acceptance of the postulates of physical science, whether we regard them as the attributes of a real objective world or merely as explanatory hypotheses, brings with it an avalanche of consequences which has not always been foreseen or enjoyed by the unwary adventurer in science. Once they are accepted, we cannot arbitrarily set a limit to their application and reserve a favored corner of our experience for consideration in other ways. Only empirical evidence of such limits can justify the claim to their existence. I have attempted to show that the so-called phenomena of consciousness do not constitute such a limit. Physical postulates are as fully applicable to mind as to the material world and there are no subjectively definable attributes of mind which distinguish it from other physical processes. The acceptance of a physical world seems to me therefore to involve as a

corollary a behavioristic psychology. The various forms of psychophysical dualism strive to set apart a fragment of knowledge and to apply to it a different set of postulates without adequate evidence for the distinction. They thereby violate the principle of parsimony, while accepting it within the limits of their respective systems.

The same criticism does not apply to other systems which definitely reject one or more of the postulates of physical science as applied to any phenomenon of experience. Solipsism rejects all, idealistic monism apparently the postulates of spatial relationship and individual discreteness of elements, creative evolution the doctrine of determinism, certain mysticisms the postulate of temporal relationship, and finalism rejects determinism and substitutes values. Since each consistently rejects the postulates of the others for all experience, they are each rationally unassailable from the postulates of the other. This leads to a consideration of the psychological factors involved in the construction and choice of a system.

The Psychology of Mechanistic and Teleological Systems

The psychology of philosophy is yet to be written, although it must be included in any psychological system. The finalist must show to what purpose his speculations, and the mechanist must explain how he is become as he is. Each must show the place of his system within his system.

In so far as one can analyze it at present, physical science seems to be the attempt to express all experience in terms of bodily activity. However abstract the notions of time or space, of gravitational attraction, and the like, they are thought of in bodily movements or postures. Translation into other terms is precluded in the system and in particular all emotional elements are ruled out. The more nearly the expression can be reduced to pure movement and posture, without push or pull (kinæsthesis), the more nearly it approaches the mechanistic ideal. Advanced mathematics substitutes verbal symbols for manipulative patterns, but the symbols are first derived from the patterns, and their meaning is a reënactment of the patterns from which they

were derived or for which they are named. The apparent limitations of science and metaphysics seem to be determined by the manipulative capacities of the bodily mechanism. Scientific explanation might be called the manipulative interpretation of the universe.

In addition to manipulative activities, the organism is capable of emotional reactions and these seem to furnish the basis for the antagonistic doctrine of finalism. It stresses the emotional and utilizes the manipulative only where emotional interpretation fails to cover the phenomena of experience. This point of view is most clearly expressed in Bergson's intuitionalism. Description and 'explanation' are of less importance than valuation, and the formulation of knowledge is to be made in terms of its emotional significance.

Perhaps other modes of interpreting experience may be devised, but thus far none has been. Other positive doctrines seem to exist largely by avoidance of clear statements of their postulates and by vacillation between these two methods of thought. A few writers see the antagonism of the two views, and, as Bergson, reject determinism with all its works, or with the behaviorists finalism and values, but the majority of psychologists are still precariously bestriding both steeds.[1] Adherence to mechanism or finalism seems to be wholly a matter of temperament; the choice is made upon an emotional and not a rational basis. Perhaps the psychoanalysts, specialists in human motives, can explain the choice of a system. Their account of my behaviorism would certainly run as follows:

A strong Oedipus complex; identification of the Heavenly Father with the father of the complex; transfer of the affect to all religious dogma; rejection of soul, mind, everything which suggests transcending or paternal authority. The history is clear. Coupled with this, a tendency to 'shut-in' temperament with its resultant *Schadenfreude*; organic inferiority with compensation through a derogatory view of others. "These superior men! They are only modified

[1] The most recent spectacle of this sort is presented by McDougall (21), who bounces back and forth between accurate scientific description and the exhortations of a soap-box evangelist.

entera with gonadal appendages. Nothing but machines which can claim no credit for their achievements."

But if this is the solution of my behaviorism, are the advocates of other systems in any better case? We can imagine the psychoanalytic account. Finalism is but an attempt to magnify the ego in another way. "What! am I only an evolved enteron? By no means! I transcend mere matter. I am a free mind, a self-created and self-creating being." This, like materialism, is but another form of the 'Myth of the Birth of the Hero' (**25**).

Valuation Versus Scientific Description

The two systems, mechanistic explanation and finalistic valuation, stand out as incompatible points of view, scientific versus humanistic. To the writer, the most serious defect of current psychology is the confusion of these points of view in the attempt to develop a science. There is an almost universal demand that psychology shall do more than explain mind in the sense in which other sciences explain their material. It must also subject itself to anthropocentric values; it must leave room for human ideals and aspirations; and it must present its material in such a way as to identify the explanatory principles with some qualitative elements within the reader's experience.

Other sciences have escaped from this thralldom. The astronomer and biologist no longer need to bow before man's egotism, and their conclusions are a frank denial of his preëminence. And equally they are freed from the necessity of arousing the 'experience of the thing described.' No one asks that the physicist's account of gravity shall make his hearer feel heavier, or that the biologist shall throw him again *in utero* by his statement of the recapitulation theory.

Yet many psychologists demand that the explanation of mind shall be, somehow or other, identical with mind. The final objection to behaviorism is that it just fails to express the vital, personal quality of experience. So far as I can analyze this objection, it is based upon the demand that the scientific description shall have the affective value of the

thing described. This demand is quite evident in James' arguments concerning the 'automatic sweetheart.' It is scarcely less obvious in other cases. The objection to a physiological account of the awareness of red, for example, seems unquestionally to be based upon the feeling that the description is not red; does not give the peculiar sense of possession which is in *my* red; does not arouse the experience of red. And so for other more obscure psychological data of the sort which is supposed to involve transcendence. There is a persistent demand that the scientific description shall be capable of arousing the experience of the thing described. Such descriptions belong to art, not to science. If such is the function of psychology, then the painter, musician, and poet far excel the psychologist in the practice of his profession. And a slap in the face is a better description of anger than can be formulated in words.

Not only is there this demand for an esoteric quality in psychological studies, but there has also been a constant attempt to inject metaphysics into the science. The developments of physics are independent of any theory of the ultimate nature of matter, and it is a bold metaphysician who ventures to take the physicist to task for ignoring things-in-themselves. But psychology has ever been the playground of philosophers, ignorant of its empirical findings but confirmed in their belief in the unassailability of their introspections and determined that psychology must be made the stepping stone to a knowledge of reality and value. And psychologists have accepted these unscientific aims and attempted to make the science to conform to them. Yet things-in-themselves are, as Conger (4) has phrased it, "the limiting case of nothing" and to the scientist *qua* scientist simple nonsense, and one of the chief lessons of empirical psychology is that values are never rational but always based upon an affective reaction. It is only by divorcing itself from metaphysics and values and adopting the phenomemological method of science that psychology can escape the teleological and mystical obscurantism in which it is now involved.

IX. The Behaviorist Program

I pick up at random an elementary textbook of psychology (not written by a structuralist) which is presumably representative of current interests in psychology; the best that psychology can contribute to the culture of the student. It is made up as follows: Sensation, perception, affection 66 per cent., anatomy of the body, 10 per cent., learning, 9 per cent., thought (more than half a discussion of sensation and imagery), 9 per cent., self (metaphysical) 1 per cent. The remaining five per cent., by a stretch of the imagination may be interpreted as a discussion of human motives. Perhaps this book is not typical, but it is fairly representative of the kind of psychology that prepossession with the mind-body problem has produced. It practically ignores what to the behaviorist are the most important problems of psychology, and what to the average student are the most interesting and vital questions, the problems of human conduct. The behaviorist is interested to discover the wells of human action: how does the individual meet the complex situations in which he finds himself, how solve his problems, how acquire social conventions, whence come his interests, prejudices, ambitions, what is the source of his genius or commonplaceness? These are not the problems of the introspectionist, yet they are unquestionably psychological problems, and their importance is far from measured by the grudging five per cent. granted them in the text. Only a vision grown myopic by long introversion could behold sensory physiology as twelve times more important than all the problems of human personality combined.

It is by this demand for change of emphasis in psychology that behaviorism has broken most completely from the traditions of the older psychology, which is willing to leave the problems of every-day life to the 'applied sciences' of sociology, education, and psychiatry. The behaviorist holds that the greater part of introspective psychology is only a poorly devised physiology of the sense-organs and that its minor importance as such should be generally recognized. He would make of psychology a true science of human conduct.

By what means? From physiology we inherit reflexes, conditioned reflexes, and glands; from animal psychology, habit, trial and error, and instinct; from psychiatry, emotional complexes and conflicts; from subjective psychology, a horrible example. With this meager equipment we must begin our task. The task is first to define more clearly the problems of reaction, of motivation and integration in behavior, to analyze the behavior components in specific human activities; second, to state these in terms of the physiological mechanisms involved. Without physiology behaviorism can make but little progress, for its explanatory principles are physiological and no sharp line can be drawn between the two sciences. For the present, if we are to deal with complex human activities, we must be content with the pseudo-explanations offered by such conceptions as 'set,' 'habit,' 'gestural reaction,' 'drive,' 'conflict,' 'dominant stimulus,' and the like, but our task is not completed until we can show something more definite than these as the foundation of the science.

At present, behaviorism is based largely upon the conceptions of subjective psychology. Its categories of behavior are derived from the categories of structural psychology and its 'explanations' are largely re-phrasings of subjective descriptions. This is due in part to language difficulty, in part to the early training of most behaviorists in subjective psychology, but chiefly to the backwardness of the science of physiology.

Our current psychological language is a weird composite of teleological and mechanistic terms; names for phenomena which, as experienced, reveal neither purpose nor cause. The result is that a scientific description of many phenomena may not be recognized by those who are less familiar with the phenomena than with the names and their interpretative implications. This has led to such objections to behaviorism as that recently advanced by Pratt (24) who has argued that to make himself intelligible the behaviorist must always fall back upon subjective terms, "...has to translate half a dozen behaviorist pages into two lines of introspective psychology,

in order to clear up his meaning even to his introspectionist colleagues." Such objections have perhaps been justified by behavioristic discussions, perhaps even by this paper, but the fault lies rather with the lack of an extensive and generally understood behavioristic nomenclature than with behavioristic theory. I may say that I am hungry and purpose to have steak and onions for dinner. The subjectivist and the man-in-the-street gets the meaning clearly. Yet my words have only been accepted names for the facts that stomach contractions, salivary secretion, changes in visceral tonus, specific laryngeal and tongue movements, contractions of trunk musculature, and the like are occurring within my body. An introspective description of my *purpose* would not reveal an influence of the future on the present, nor does the behaviorist account. Yet such is the defect of language that to be intelligible to any one except the most highly specialized behaviorist, the description of the phenomenon must employ a word which implies this finalistic interpretation (the very word *implies* has connotations which the behaviorist cannot admit, yet to avoid it I must use half a page to describe the actual phenomenon of implication, as it appears to either behavioristic or introspective analysis). Only the gradual development of a widely understood behavioristic terminology can eliminate this difficulty.

To the man trained in the older psychology or philosophy the traditional problems must still seem important, even though he has thrown off most of the metaphysics of the school in which he was trained. Moreover, unless he has first-hand knowledge of a vast range of human activity he must take his facts from the subjective literature where they are arranged and selected with the subjectivist's bias as to their relative importance. Small wonder then that current behaviorism shows the taint of introspection. Where the behaviorist is engaged in experimental work and is not trying to construct a system, this difficulty is by no means so evident and the few behaviorist investigations which have appeared are certainly not open to Pratt's criticism that the problems are derived from subjective psychology.

The behaviorist's chief handicap is the lack of an adequate physiology upon which to base his science. The exaggerated emphasis upon conditioned reflexes, suprarenal glands, and 'sets' shows the paucity of the material at hand. But by turning physiologist the behaviorist may hope to enlarge the number of his explanatory mechanisms and by a wider direct contact with human problems to escape the subjective categories under which they are now classed.

In this respect we need some compromise between the positions recently advocated by Warren and by Weiss (**28, 29, 36**). Weiss would make of behaviorism a science based upon the "individual-social" aspect of reactions, utilizing physiological results only as a basis for social valuation. Warren emphasizes the neuro-physiological problems of behavior.

The social categories of Weiss are certainly open to further analysis and must always be questionable—mere hypothecated processes or names for ill-defined groups of phenomena —until their neurological mechanisms have been solved. On the other hand, if behaviorism is to treat of human conduct, it must for the present employ such vague categories. The insistence upon neurological interpretation can now only lead to the formulation of preposterous neurograms or to the restriction of behavioristic research for many years to the physiology of the simplest neural processes. The compromise must include a healthy scepticism toward the present behaviorist categories, an insistence that the problem of their physiological mechanism be kept always in mind, with a full recognition of their practical value for systematizing the problems of human conduct.

Behaviorism began as a criticism of introspection. Must it retain as fundamental to its tenets the objection to any form of verbal report from its subjects? Certainly such reports are not necessary for a recognition and study of central processes. The whole concept of neural integration and the detailed accounts of spinal mechanisms which are now possible have been derived without recourse to introspection. On the other hand, there can be no valid objection

by the behaviorist to the introspective method so long as no claim is made that the method reveals something besides bodily activity. Behaviorism has a place for introspection, but it must be a vastly different form of introspection from that which now burdens the literature. Its avowed aim must be the discovery of cues to physiological problems and its final appeal for verification to the results of objective methods. Such introspection may make the preliminary survey, but it must be followed by the chain and transit of objective measurement.

The physiological analysis of human behavior presents a stupendous, perhaps insuperable task. It has not been my object here to develop specific physiological theories to formulate a system of behaviorism, or to prophesy the course which its development will take, but only to point out that the supposed problem of consciousness does not present insurmountable difficulties to behavioristic treatment. Subjective psychology has not revealed data which justify any type of psychophysical dualism. The attributes of mind, as definable on introspective evidence, are precisely the attributes of the complex physiological organization of the human body and a statement of the latter will constitute as complete and adequate an account of consciousness as seems possible from any type of introspective analysis. The behaviorist may go his way without fear that his final account will fail of including 'mind' and with the conviction that the inclusion of 'mind' will add nothing to scientific psychology.

LITERATURE CITED

1. BAWDEN, H. H. 'The Presuppositions of a Behaviorist Psychology,' PSYCHOL. REV., 1918, 25, 171–190.
2. BECHTEREW, W. v. 'La psychologie objective,' Paris, 1913.
3. BERGSON, H. 'Creative Evolution,' N. Y., 1911.
4. CONGER, G. P. 'The Implicit Duality of Thinking,' *J. of Phil.*, 1922, 19, 225–237.
5. DEWEY, JOHN. 'Concerning Alleged Immediate Knowledge of Mind,' *J. of Phil.*, 1918, 15, 29–35.
6. DRIESCH, H. 'The Science and Philosophy of the Organism,' London, 1908.
7. DUNLAP, K. 'Dr. Yerkes' View of Psychic Causation,' *Psychol. Bull.*, 1911, 8, 400–403.
8. FERNBERGER, S. W. 'Behaviorism versus Introspective Psychology,' PSYCHOL. REV., 1922, 29, 409–413.

9. FISHER, S. C. 'The Process of Generalizing Abstraction; and its Product, the General Concept,' *Psychol. Rev. Monog.*, 1916, 21, v + 213.
10. FROST, E. P. 'Cannot Psychology Dispense with Consciousness?' PSYCHOL. REV., 1914, 21, 204–211.
11. HALDANE, J. S. 'Mechanism, Life, and Personality,' N. Y., 1914.
12. HOLT, E. B. 'The Concept of Consciousness,' N. Y., 1914.
13. HOLT, E. B. 'The New Realism,' N. Y., 1912.
14. JAMES, W. 'Principles of Psychology,' N. Y., 1890.
15. KOFFKA, KURT. 'Perception: an Introduction to the Gestalt-Theorie,' *Psychol. Bull.*, 1922, 19, 531–585.
16. LASHLEY, K. S. 'Studies of Cerebral Function in Learning. No. III. The Motor Areas,' *Brain*, 1921, 44, 255–286.
17. LOEB, J. 'Comparative Physiology of the Brain and Comparative Psychology,' N. Y., 1900.
18. LOVEJOY, A. O. 'The Paradox of the Thinking Behaviorist,' *Phil. Rev.*, 1922, 31, 135–147.
19. MARSHALL, H. R. 'Behavior,' *J. of Phil.*, 1918, 15, 258–261.
20. McDOUGALL, W. 'Body and Mind,' N. Y., 1913.
21. McDOUGALL, W. 'Prolegomena to Psychology,' PSYCHOL. REV., 1922, 29, 1–43.
22. MONTAGUE, W. P. 'The New Realism,' N. Y., 1912.
23. PRATT, J. B. 'The New Materialism,' *J. of Phil.*, 1922, 19, 337–351.
24. PRATT, J. B. 'Behaviorism and Consciousness,' *J. of Phil.*, 1922, 19, 596–604.
25. RANK, O. 'The Myth of the Birth of the Hero,' N. Y., 1914.
26. SHELDON, W. H. 'The Soul and Matter,' *Phil. Rev.*, 1922, 31, 103–134.
27. TITCHENER, E. B. 'Experimental Psychology of the Thought Processes,' N. Y., 1909.
28. WARREN, H. C. 'Psychology and the Central Nervous System,' PSYCHOL. REV., 1921, 28, 249–269.
29. WARREN, H. C. 'Awareness and Behaviorism,' *Phil. Rev.*, 1922, 31, 601–605.
30. WASHBURN, M. F. 'Movement and Mental Imagery,' Boston, 1916.
31. WATSON, J. B. 'Psychology as the Behaviorist Views It,' PSYCHOL. REV., 1913, 20, 158–177.
32. WATSON, J. B. 'Is Thinking Merely the Action of the Language Mechanisms?' *Brit. J. of Psychol.*, 1921, 11, 87–104.
33. WEISS, A. P. 'Relation between Structural and Behavior Psychology,' PSYCHOL. REV., 1917, 24, 301–317.
34. WEISS, A. P. 'Relation between Functional and Behavior Psychology,' PSYCHOL. REV., 1917, 24, 353–368.
35. WEISS, A. P. 'The Mind and the Man Within,' PSYCHOL. REV., 1919, 26, 327–334.
36. WEISS, A. P. 'Behavior and the Central Nervous System,' PSYCHOL. REV., 1922, 29, 329–343.

THE STIMULUS–RESPONSE FALLACY IN PSYCHOLOGY

BY L. L. THURSTONE

Bureau of Public Personnel Administration, Washington

In psychology we talk very much about the stimulus and the response. I am almost inclined to believe that no other words in psychological terminology occur more often. About these two terms we have come to take for granted a point of view for psychological analysis, the validity of which I want here to question. By the stimulus-response formula in psychological writing I mean the assumption that mental life is essentially determined by stimuli and that our actions are in the nature of replies to the stimuli. We write and talk as though the stimuli were primarily provocative of mental life and of our actions. When we meet any mental phenomenon which is to be explained we look first for a stimulus. If we find one we assume that the first requirement of a scientific explanation has been met. If we cannot find a stimulus which is obviously responsible for the present mental state, or for the present overt act, we rest convinced nevertheless that some stimulus in our past is now finding expression in us. We must have a stimulus for otherwise we cannot psychologize.

A mental phenomenon is to be explained. It is very simple. What was the stimulus? Describe it. What was the muscular response? Describe it objectively. What happened between these two things? There were 'bonds' between them, and 'pathways,' and 'grooves,'—and 'processes' took place, and there were 'connections' in the nervous system. That settles it, and the event is psychologically explained. In order to make our teaching clear we draw three lines on the blackboard with 'fuzzy' ends to represent neurones and synapses. Our amateurish neurology is passed out as a scientific discussion of mental life, when there is really nothing

mental about any of these things, the physical stimulus, the muscular response, and the blackboard neurones.

In Figure 1, I have represented this stimulus-response

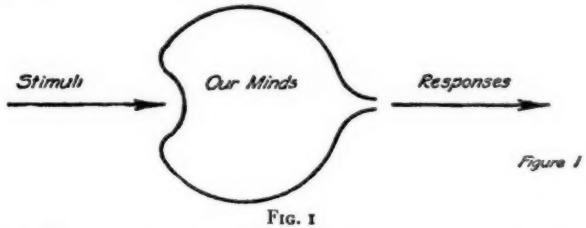

FIG. 1

psychology in a simple diagrammatic way. A stimulus hits us. The mind consists of the so-called bonds and pathways, and out comes the response. When we see a muscular adjustment we point to a known, or unknown, stimulus which has found its way transformed through bonds and pathways into conduct. It would hardly be fair to say that we are always as totally unmindful of the mental in our mental science as my simple diagram would indicate, but I am calling in question the stimulus-response formula which is explicit or implied in much of our psychological writing. To relegate habitually our mental life into the unmental stimulus-response categories is a procedure that carries the appearance of science in its terminology but it is often indicative of a superficial and unsympathetic understanding of mental life.

In Figure 2, I have represented the function which, it

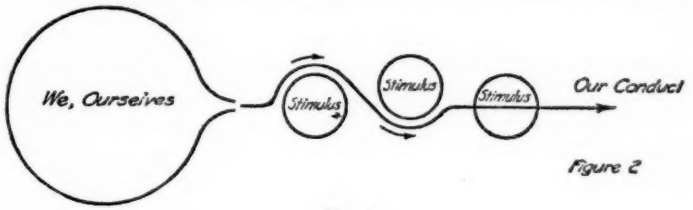

FIG. 2

seems to me, the stimulus really serves. Let us start the causal sequence with the person himself. Who and what is he? What is he trying to do? What kind of satisfaction is he trying to attain? What are the large types of self expres-

sion that are especially characteristic of him? What are the drives in him that are expressing themselves in his present conduct? Let us consider the stimuli as merely the environmental facts in terms of which he expresses himself. In the the diagram I have represented the causal sequence as starting with the dynamic living self. Self expression is defined into particular actions at the terminal end of the diagram. The environment, the stimulus, is causally intermediate. The stimulus determines the detailed manner in which a drive or purpose expresses itself on any particular occasion.

In the last analysis the datum for psychology is the dynamic living self and the energy groups into which it may be divided. We may refer to this datum as the will to live, or we may call it the life impulse, or the vitality of the organism, or we may discover it to be the energy released by metabolism. We may be able to subdivide our will to live into large energy groups which manifest themselves in conduct more or less independently. These energy groups would be our innate, dynamic, and more or less distinct sources of conduct, and we might come to call them drives, motives, instincts, determining tendencies, or any other words that represent that which we as individuals innately really are, that which characterizes us as persons with individually preferred forms of life.

With our interest thus centered on the dynamic aspects of the living person himself, we are in a position of good perspective from which to study the manner in which he utilizes the stimuli of his environment, the manner in which he goes about hunting for the stimuli that the environment does not immediately give, the manner in which his dynamic self finds overt expression through and by the stimuli that by chance happen to be available, and his compromises with substitute stimuli which in other moments he would reject as inadequate. The stimulus is not primarily provocative of living, of mental life. We, ourselves, are.

If we consider the causal sequence of Figure 2 we have first the presence of drives, tendencies, or motives in us. These conscious or unconscious motives become in the second phase

of the sequence more and more defined through the stimuli of the environment, and they issue in the third phase of the sequence in overt action. Let us call this sequence a *psychological act.* An overt act is then merely the terminal end of a psychological act. The stimulus may be defined materially as any physical event in the environment, but psychologically the stimulus would be defined as a motive that is being formed. The complete formulation of a motive is an overt act. Hence the stimulus is a motive that is partly formed, but not yet completely formed into overt action. This represents briefly the causal sequence which should be the fundamental concern of psychology.

One of the basic problems in psychology is necessarily the classification of actions and their incomplete forms which constitute conscious life. There are at least six different bases by which actions may be classified. The simplest of these is that of direct similarity of the overt acts themselves. To pick up a fork and to pick up a fountain pen are two acts that are closely similar and they may for certain narrow purposes be classified together. Psychologically two such actions are totally different in two respects. The mental antecedents of the two overt acts are totally different, and the consequences and immediate satisfactions are also different. If we compare the two psychological acts that are involved we find that they converge at one point only, namely, at the point where the motives or purposes issue into overt expression. Before and after this point the two acts and their consequences cannot be classified together. From the standpoint of the psychologist it is a trivial circumstance that the two psychological acts happen to terminate in the same muscle groups.

We may proceed in either direction, through the antecedents or through the consequences of the act, in order to discover other bases for classifying action. Let us go to the antecedents first. If two psychological acts are similar in the mental antecedents of the overt acts, the two resulting actions may for that reason be classified together. Suppose that you discover that some information should be given to another

man. This is a mental state and it is therefore unfinished action. The resulting overt formulation of the psychological act may take various forms. You may reach for the telephone, or you may put on your hat and coat and walk out. These two seen forms of behavior are, of course, different in appearance, but there was a point in the mental antecedents of two such possible actions at which they would be identical, namely, that stage in the formulation of behavior at which it is merely the realization that some information should be conveyed. Two widely different overt acts may, then, have converged, and they may have been identical, at some mental antecedent stage. We see that if we define the psychological act as the whole course of events from a purpose or motive, through its imaginal form, through the overt expression, to the consequences and satisfactions to the actor, we have numerous points at which different psychological acts may be treated as identical even though they differ widely at other stages.

Two acts may be declared to be in the same category because of the fact that they converge and are identical at the point where the stimulus appears. The stimulus for the exteroceptors constitutes a relatively late and rather completely formulated phase of the psychological act. The stimulus for the interoceptors constitutes an earlier and less definitely formulated phase of behavior. It often happens that a stimulus for the interoceptors is the first conscious presence of the unfinished behavior which completes itself in a hunt for suitable stimulation of the exteroceptors. These latter stimuli in turn complete themselves as ordinary percepts in overt action and resulting satisfaction or a continued hunt for more stimuli. Two psychological acts may be declared to belong in the same category because of the similarity of the internal or external stimuli by which the several lines of unfinished behavior converge or are identical.

A more important and fundamental basis of classification would be the possible identity of several types of behavior at their energy source. It may be possible to discover that the total energy of the organism, which is derived from its metabolism, is divisible into energy groups. It is not impossible

to imagine that in one organism much of the energy may turn to digestive functions with resulting keen interest and satisfaction in food. In another organism a relatively smaller proportion of the energy which it accumulates is turned into this direction. There may well be individual differences in the division of the total energy of the organism into the several groups which constitute the source of its life impulses. In a similar manner organisms of the same species may differ in the relative proportion of their total energy which normally goes into the sex functions. In the human it is also conceivable that there are individual differences in the proportions of energy which normally seek expression in aggressive and self-assertive behavior, in sex life, in digestion, in locomotion, in gregarious conduct, and so on. It may well be that the different behavior of the prize fighter and the scholar converge as identical in that early phase of their conduct in which both seek social approval. Both may be so absorbed in the immediate details of what they are doing that they do not consciously realize the identity of the source of their labors.

It is in these energy sources of conduct that we shall find the distinctions between instincts. Instincts can never be defined in terms of the stimuli by which we happen to express ourselves; nor can they ever be defined in terms of particular behavior on particular occasions. The futility of the instinct category in psychology is caused by the fact that we have been looking for a specific stimulus on which to attach a specific instinctive response. The sex instinct, for example, should be defined so as to include the total range of possible human conduct, and the total range of human stimuli. The only point in the great variety of behavior at which the psychological acts belonging to an instinct are identical is at the energy source.

If, instead of proceeding from the overt act toward the mental and the unconscious antecedents, we follow the psychological acts into their consequences, we find still additional points at which they may converge. Two psychological acts may be totally different but they may conceivably have similar immediate consequences as objectively determined.

Such a fact would be a legitimate basis of classification. The subjective variant of the above classification on the basis of immediate consequences is to group together those psychological acts which yield for the actor the same types of satisfaction.

Still another basis for classifying actions together is the degree to which they may be substituted with equal satisfaction to the actor. This is one of the most useful explanatory devices in psychology.

I have listed a number of stages in the development of psychological acts in which they may be identical or similar. If we start with action at its source and follow the stages through which it becomes formulated into conduct, and the consequent satisfactions, we shall have a table as follows:

THE STAGES OF THE PSYCHOLOGICAL ACT

(1) Energy source
(2) Reduced threshold for stimuli
(3) Deliberate ideation
(4) The internal stimulus
(5) Imaginal hunt for external stimuli
(6) Overt hunt for external stimuli
(7) The external stimulus
(8) The consummatory overt act
(9) Overt consequences of the act
(10) Satisfaction to the actor, and quiescence at the energy source

(1) *The energy source* is the dissatisfaction in the physiological, mental, and social conditions which provokes action. These physical and mental conditions cover such wants as the satisfaction of hunger, bodily comfort, sex, social approval, social power. A state of dissatisfaction in any one of the instinct conditions is the starting point for action which is maintained until satisfaction is attained. Two actions belong in the same instinct category if they can by conditioning be readily substituted for each other. Two actions belong in different instinct categories if they can only by prolonged conditioning be substituted for each other. It may be that

the instinct sources of behavior are not truly energy groups but only physiological and mental conditions which make demands on the total energy supply of the organism for random or purposive behavior until conditions of satisfaction are attained.

(2) *Lowered threshold for stimuli.* When an instinct condition is in a state of dissatisfaction there results a lowered threshold for relevant stimuli long before the appearance of conscious need, desire, or purpose. At five o'clock in the afternoon we are normally more easily tempted by the smell of a good steak than immediately after lunch, but in the absence of the external stimulus we may be entirely unaware of the lowered sensory and interest threshold. The instinct condition by its lower threshold has already started to determine the ultimate behavior before any conscious or external indices appear. The behavior is already on its course of formulation before the internal or external stimulus appears.

(3) *Deliberate ideation.* In a dissatisfaction which has not yet become sufficiently acute to be conscious in sensory form, and in which the actor is not himself aware of the lowered interest threshold, the expected behavior appears in imaginal form. Biologically the purpose of ideation is to prepare for action. The actor himself may not be aware of the fact that his thinking has its source in some state of incompleteness or dissatisfaction in the physical or social self. Since the need is not urgent or explicitly conscious, the actor's thinking is correspondingly calm and deliberate.

(4) *The internal stimulus* is parallel to the stage of deliberate ideation in the formulation of behavior, but it represents, in those instinct conditions where it normally takes part, a more definitely specified form of the behavior than the ideation which precedes or accompanies it.

(5) *Imaginal hunt for the external stimulus* represents a later and more complete formulation of behavior than free-moving purposeless thought and its relatives in internal stimuli. At this stage of the definition of conduct we have the expected experience in conscious form, and it has taken sufficient definition to be introspectively recognized as purpo-

sive. It is in reality an imaginal hunt for those suitable stimuli which, if found, would lead to consummatory action. It is purposive imaginal preparation for expected experience. Expected conduct is now beginning to take sufficient cognitive form to be the subject of imaginal trial and error choice. This is realistic thinking which is purposive, as contrasted with autistic thinking which is less definitely purposive. Both forms of thinking are driven by instinct conditions.

(6) *Overt hunt for external stimuli* is merely carrying the purposive thinking into action in the hope of finding the imaginally expected stimuli. These overt actions may be directed immediately toward the significant stimulus, or they may be random in the nature of overt trial and error. It happens not infrequently that an instinct condition leads to overt random search without any conscious purpose, and without any definite conscious realization of the nature of the satisfaction that is sought.

(7) *The external stimulus* represents a rather late stage in the formulation of behavior. The psychological act is almost completed at the appearance of the external stimulus. The meaning of the stimulus is the expected satisfaction of the instinct condition for which the organism is ready. Most of the external stimuli are consciously sought, hunted for. The external stimuli which appear suddenly, such as danger signals, have as their meaning the maintenance of bodily integrity, a condition which by the mere fact of living the organism is in constant readiness to maintain. It should be noted, however, that the great majority of external stimuli are not met fortuitously. We actually hunt for most of our stimuli.

(8) *The consummatory overt act* is the terminal of what I have called the psychological act.

(9) *The overt consequences of the act* are in most cases practically parallel with the consummatory act and with the satisfactions to the actor.

(10) *Satisfaction to the actor.* It should be noted that the beginning of this sequence and the end of it are closely related in that both are concerned with the degree of satisfaction of

the physical and mental instinct conditions. Behavior starts in dissatisfaction and it terminates in satisfaction. It is in this sense that we can speak of a reflex circuit rather than the reflex arc. We have traced the psychological sequence by which behavior is formed. The mental antecedents of behavior constitute in fact behavior in the process of being particularized.

Every scientific problem is a search for the functional relation between two variables. In psychology we have two systems of variables that are to be related; namely, the motives or drives on the one hand and their overt expressions on the other. Instead of selecting these two systems of variables we more often attempt to express action as a function of the stimulus. Since the stimulus is a partly defined motive or drive there is no doubt frequently a relation between the stimulus and the overt act, but it is not nearly so fundamental for the understanding of mind, human nature, and conduct as is the relation between the drive at its source and its overt expression. The particular stimulus in any experiment may not be the one which the momentarily dominant motive cares to select for its expression.

Let us consider a typical illustration. I have said that we are in the habit of describing action as a function of the stimulus. We place before a subject a tachistoscope and he sees nonsense syllables. He tries over and over again until he has learned them. Out of this psychological experiment comes the scientific deduction that, other things being equal, he remembers best those syllables which are at the end of the list and which he saw last. He tends to remember also quite well those syllables that he saw first, before the novelty wore off. He does not remember so well the syllables in the middle of the list. This is a scientific experiment in which we state the relationship between two variables. The answers of the subject are described as a function of the stimulating nonsense. But how about incentives? The most important factor is whether or not he cares about our nonsense syllables. This factor of interest and effort overshadows entirely the small effects of the arrangement of the syllables. The experiment

is scientifically quite legitimate but it is trivial relative to the factors that are most important for mental life.

We recognize of course this fact, that incentives are more important than the arrangement of the syllables on the page in predicting the recall. But since the incentives are not really measured, we have been content to describe the relations that we can measure. Well and good. This would not be subject to criticism if it were not for the fact that we have come to forget the individual person altogether. Experiments of this type have come to be the rule and we have taken for granted that psychology is primarily concerned with the incidental relation between the response and the response-modifying stimulus. We have gone so far as to assert that psychology studies the stimulus-response relation, and we have forgotten the person himself who may or may not want to do the responding.

I suggest that we dethrone the stimulus. He is only nominally the ruler of psychology. The real ruler of the domain which psychology studies is the individual and his motives, desires, wants, ambitions, cravings, aspirations. The stimulus is merely the more or less accidental fact in the environment which becomes a stimulus only when it serves as a tool for somebody's purposes. When it does not serve as a tool for getting us what we want, it is no longer a stimulus. It is not a cause. It is simply a means by which we achieve our own ends, not those of the stimulus. The psychological act which is the central subject-matter of psychology becomes then the course of events, primarily mental, which intervene between the motive and the successful neutralization or satisfaction of that motive. The stimulus appears somewhere between the provocative and overt terminals of the psychological act. Mental life consists primarily in the approximate formulation of the motives leading toward overt expression. To the extent that mental life is of a relatively high order these approximate formulations of the motives become more and more tentative, deliberate, inhibited, delayed, and subject to choice before precipitating into their final overt form.

This point of view that I am recommending is not so

radical as it might at first sight appear. What I am recommending is after all merely a shift of emphasis diagrammatically represented in Figure 3. In that figure the upper line

THE STIMULUS . . . THE INDIVIDUAL . . . THE RESPONSE
THE INDIVIDUAL . . . THE STIMULUS . . . BEHAVIOR

FIG. 3

represents the causal chain tacitly followed by psychology as it is now usually written. This chain of events starts with the stimulus as the fundamental datum for psychological inquiry. From the stimulus as a source we trace the mental events to the response. Between these two terminals we place the characteristics of the individual in the form of modifying mental sets, predispositions, irritability, instincts, habits. We admit that the individual does enter into the causal chain but only as a modifier of the stimulus-response series. When we talk about instincts, for example, we look first of all for a suitable stimulus which can be given the credit for starting the instinctive behavior. The stimulus is assumed to be the absolutely essential starting point for an instinctive act. At the other end of the causal chain we set down the characteristic behavior which is brought about by the particular stimulus. Between these two events we assume that the individual himself has something to say but only as a modifier of the fundamental stimulus-response relation.

In the second line of Figure 3, I have represented the individual and the stimulus as exchanging their places. The individual is in this second representation assumed to be the starting point for that which he himself does. The stimulus takes the secondary rôle of modifier. The primary formula is then to be found in the motive-expression relation. The expression of the motive is, of course, markedly affected by the stimuli which are now to be considered as the momentary circumstances of the environment. I am simply shifting the stimulus to the secondary rôle of a modifier, and I am promoting the individual and his life impulses to the first rank of cause as far as psychology is concerned.

Let us consider an illustration. Consider the instinctive

adjustments of retaliation for an insult. The insult would be described as a stimulus. Your defense would be described as a response. If you have lately been on the defensive as regards your position, professional status, financial security, or health, your motive of self defense or self preservation would have a low threshold. A trivial remark from an insignificant source might be sufficient to arouse defensive conduct on your part such as a fist blow, loss of temper, loud self-assertative talk, sullenness, or a bossy manner toward associates. If you have lately enjoyed a feeling of relative security with reference to your social, professional, financial, and physical self, the threshold for this defensive behavior would be so high that the trivial remark would be passed unnoticed. If you do reply to it, one would of course say that the insulting remark came first, and that your reply came afterward. But such a stimulus-response analysis of the situation would be superficial. It would not be the remark that drove you on to defend yourself. The stimulus is only an environmental fact which determines partly how you express what is already in you. It is psychologically much more interesting to discover the tendencies that seek expression than to describe conduct as merely replies to stimuli.

Suppose that you are stalled on a country road on account of an engine which has been maltreated. There were surely stimuli that preceded your inspection of the engine. That which makes you do things to that engine is not primarily the stimuli from the engine—it is your desire to go. The stimuli are simply environmental facts which modify the expression of your desire to get there.

It may well be that our stimulus-response habits in psychological discussion came about because of the obvious fact that the stimulus often precedes conscious solution, and this in turn often precedes the overt act. The insulting remark no doubt preceded your back-talk; the engine balked before you looked for the trouble. That is all true, but your unsatisfied desire for security was active as an unlocalized irritability before the insulting remark was made, and your desire to keep on going was being actively satisfied before the engine

balked. The facts of apparent temporal sequence should not blind us to the major causal factors of mental life.

This point of view is not limited to the interpretation of the human mind. It applies as well to the behavior of the lower organisms. We are too often inclined to look upon the animal mind as consisting of nothing but reflexes acting in response to the stimuli that happen to strike it.

Let me quote from Jennings.[1] "Activity does not require present external stimulation. A first and essential point for the understanding of behavior is that activity occurs in organisms without present specific external stimulation. The normal condition of Paramecium is an active one, with its cilia in rapid motion; it is only under special conditions that it can be brought partly to rest. Vorticella, as Hodge and Aikins showed, is at all times active, never resting. The same is true of most other infusoria and, in perhaps a less marked degree, of many other organisms. Even if external movements are suspended at times, internal activities continue. The *organism is activity*, and its activities may be spontaneous, so far as present external stimuli are concerned. . . . The spontaneous activity, of course, depends finally on external conditions, in the same sense that the existence of the organism depends on external conditions. Reaction by selection of excess movements depends largely on the fact that the movement itself is not directly produced by the stimulus. The movement is due, as we have seen, to the internal energy of the organism. . . . The energy for the motion comes from within and is merely released by the action of the stimulus. It is important to remember, if the behavior is to be understood, that energy, and often impulse to movement, come from within, and that when they are released by the stimulus, this is merely what James has called 'trigger action.'"

I will, of course, admit that the life impulses depend on the environment. So does the very life of the organism. The life impulses may be derived from the metabolism of the organism, and this is in turn contingent on what the environ-

[1] Jennings, 'Behavior of the Lower Organisms,' Chapters 16 and 18.

ment gives. That is all true. But I should insist that psychology begin with the life impulse as its datum and that it be concerned with the mental routes by which the impulse expresses itself. It is up to the biologist to tell us the course of events by which the environment gives us our vitality. It is up to the physiologist to tell us about the physical routes by which the life impulse expresses itself.

The life impulse has, then, a history leading back to past stimuli but the sequence from these stimuli to the accretion of vitality is a biological rather than a psychological problem. Except for some division of the task one could readily find one's self arguing in a circle as to what it is that starts the whole business, the life impulse or the stimulus. I prefer to consider mental life as an irreversible process beginning with the life impulse and terminating in the overt act. The stimulus may be thought of as a means for specifying the approximate act which is mental. Present overt action, and the approximate actions which constitute mental life, can only very roughly be stated in terms of the individual's stimulus-history.

The shift of emphasis that I am recommending would probably result in a more comprehensive and sympathetic understanding of mental life and human nature. It may also prove to be more serviceable to the related social sciences, and more illuminating to common sense.

Summary

My main thesis is that conduct originates in the organism itself and not in the environment in the form of a stimulus. Instead of analyzing behavior in the form of stimulus-response we should analyze it as the expression of cravings that originate in the organism and find particular modes of satisfaction in the stimuli that happen to be available.

All mental life may be looked upon as incomplete behavior which is in the process of being formed. The first phase in the expression of a craving is the lowering of the thresholds for stimuli that are relevant. Phantasy consists in cravings which have no available stimuli for their expression. Purpo-

sive thinking is the more restricted imaginal anticipation of satisfying experience. Imagination is the anticipatory hunt for suitable stimuli through which a craving may be satisfied. Perception is the discovery of the suitable stimulus which is often anticipated imaginally. The appearance of the stimulus is one of the *last* events in the expression of impulses in conduct. The stimulus is not the starting point for behavior.

THE ORGANIC SETTING OF THE PROBLEM OF THINKING

BY J. A. MELROSE

Janesville, Wis.

Thinking is not an isolated fact. It is part of the datum of psychology. It is the final step in an *organic learning process*. The aim of this discussion is to locate thinking definitely in its place in the learning process and so in its correct setting in the total datum of psychology. This should enable us to see thinking in distinction from other forms of learning which in actual practice integrate with it and confuse the problem. It should make the *distinctive* characteristics of thinking prominent—that is, mark thinking off *in its uniqueness*—thereby defining the problem in a natural way and making it ready for analysis as a separate problem.

This is the *organic serial* approach to the problem. So empirical an approach does not appear to be considered necessary. We do not deem the *serial* approach essential to success in analyzing thinking and it is not in fact required in current theory of scientific practice that we should. It is everywhere customary in science to break problems up in a quite optional and arbitrary manner. It is not considered unscientific to do so. On the contrary we abstract problems off from their real setting as usual scientific procedure, and the practice happens to work pretty well in the inorganic sciences with certain exceptions.[1]

But this method has more serious limitations in organic science. In this field the *serial approach is uniformly necessary*. This is due to the subtlety of organic integrations. So smooth are they and so deceptive, that the serial approach is the only one which can, as a rule be depended upon to

[1] Einstein has pointed out the fallacy of such abstracting in the field of celestial physics and the study of the interior of the atom. Physics is, however, only one field of relativity and not the basic one. More good work needs to be done to straighten out scientific theory. Psychology offers the primary field for such a task.

locate the line which separates distinct organic elements. This serial approach is in some problems naturally and unconsciously followed, and of course 'all goes well' in such cases without conscious attention to it. But this is by no means always the case, and it surely has not proved to be the case in the problem of thinking.

Accordingly it is most important that the complex problem of thinking be approached with reference to its serial place in the learning process. This does not merely mean that it be discussed *with reference to* other forms of learning. This is, I suppose, in some sense inevitable and is always done. It means rather that the problem of thinking must be *blocked in its proper place in an organic learning process* before we are even ready to discuss it. Until this is done we are not orientated to it. Until we are orientated to it *as it is in nature* the experimentalism of our so-called scientific method is merely specious. We are not ready for analysis and are pretty sure to have scant success if we attempt it.

Former papers have driven the stakes for this one.[1] These papers (1) discussed the structure of the learning of sub-human animals and (2) defined the problem of thinking—the problem of distinctively human learning—in behavioristic terms. We are now to attempt to place thinking, viewed behavioristically, in correct and definitive relation to the structural types of lower learning as we found them in the adaptive behavior of animals.

The paper on animal learning set forth the six types by which sub-human animals make their learned adaptations.[2] It will be sufficient for present purposes to examine very

[1] 'The Structure of Animal Learning,' PSYCHOL. REV., 1921, 28, 189–221 gives the *types* of learning by which sub-human animals make their learned adaptations. Two papers deal with the problem of distinctively human learning—'The Crux of the Psychological Problem,' PSYCHOL. REV., 1922, 29, and 'The Organismal Point of View in the Study of Motor and Mental Learning,' PSYCHOL. REV., 1922, 29. In these papers thinking is defined in terms of language behavior. Language habits are, however, not defined with reference to muscular and glandular reactions but language is treated as a discursive sign-system spoken and heard.

[2] The six types which, together with their integrations, preside over animal learning are Fixation, Organic Space Adaptation, Organic Choice, Organic Association, Organic Conception, and Organic Judgment. These are isolated in their evolutionary order in 'The Structure of Animal Learning.'

briefly the last two of the six types—'*organic conception*' and '*organic judgment.*' These lie just below human learning and are employed only by the highest animals. While they are strictly motor types they look in action so convincingly like thinking that it is not an over-indulgent use of language to call them '*organic thinking.*' This great similarity between these types and 'thinking' marks the subtlety of our problem which is to make a clear structural distinction between them.

The task of making this distinction requires the serial approach. We need to see 'thinking' in juxtaposition to this *motor* thinking which looks so much like it, and make a distinction which will mark it off in its uniqueness. This may still be a rough description of 'thinking,' but it will be a meaningful one and prepare the way for analysis as to the exact structural elements that are added to 'motor thinking' to arrive at 'thinking' as we humans are capable of using it. Let us then discuss 'organic conception' and 'organic judgment' with this problem in mind. We cannot do better perhaps than repeat illustrative material from the former paper.

Hobhouse tested a fox-terrier by taking her in a box to the second floor of a strange house. The dog's master called her from without and the dog saw him from the window. After some hestitation "the dog started off and went steadily out of the door, downstairs, out of the house door and round the corner to her master."

Again: "A dog is held at the back of the house, and sees his master go in through the back door, and re-appear at the dining room window, which looks in that direction. After trying to follow his master through the back—unsuccessfully because the door is shut—he makes off around two corners to the front door and so into the dining-room. He had never been in this room before but has once been from the back into the house by the front door."

Once more: "A little fox-terrier had once found her way from the back of the house through the front door into the dining-room to her master. I then took her out again, her master remaining where he was, to the same place outside,

closing the front door behind me. After trying the front door several times she at last set off around a further corner of the house, and found the side door, through which she got into the house and found her master." Hobhouse believes these dogs found their way by "familiarity with houses, staircases, rooms, and doors" and by apparent use of what in humans we call 'common-sense.' He finds a place in this learning for 'practical ideas' and 'class inference.'

Now these adaptations represent behavior based upon past experience and yet such that it is not wholly determined by past experience. The pattern is clearly not fixed, but accommodates itself more or less readily to particulars of the problem at hand. That is, there is more than mere one-to-one association between the present problem and some past situation. There is something general about the behavior—an element of discursiveness and freedom—and it is this which makes Hobhouse conclude that there are 'practical ideas' and 'class inference.'

We have, however, attempted to explain the behavior of house-broke dogs upon a purely organic basis, and have named the type of learning involved in the process '*organic conception.*' The fact is, motor adaptation to houses naturally brings into prominence certain *repeated* elements, and this fact, together with the general *integrating process* of organisms, builds up the organic complex upon which the above behavior and similar reactions are based. In the examples above the functional aim of the dog is to get to his master. Put more generally, it is to get from place to place about and in the house. Now repeated experience under this aim naturally brings into prominence such constant elements of the problem as 'staircases, rooms, and doors,' but there is no need to assume that these elements are isolated out as *separate concretes* from the general total. On the contrary they mark the high points of the problem and they merely come by repeated experience to have their natural importance within the general environmental problem. There is no need to assume the use of 'ideas.'

For, as we have noted, experience with houses (having

functional reference as all other experience does) naturally stamps in the effects of environmental factors with reference to their *relative constancy*. This fact together with the *integrative action* of the organism accounts for both the constant and variable elements of the behavior. For example, some parts of houses are very constant; such as gables, doors, windows, stairs, etc. Other facts like 'appearance of doors,' and 'relation of doors to porches,' and the manner in which 'sidewalks and paths lead to doors' are more or less constant. Even less constant perhaps are 'appearance of front porches' or the 'relation of back and side door to front door.' Still other factors are fairly constant while some vary greatly from house to house. As a result of these general facts, increasing experience with motor adaptation to houses leads to an organization of behavior which is quite complex and ranges from rather constant elements to highly variable elements. There is constant behavior to constant factors, selective behavior to fairly constant elements and 'trial' behavior toward variable elements with various intermediate stages.

The repertoire of behavior exhibited then by the housebroke dog is the natural accumulated result of the *stamped-in and integrated effects of experience*. There is no need to make appeal to 'class inference' as we employ it in thinking. Nevertheless we should note how near we come to this. We have in this organization or integration of experience upon the basis of relative constancy of factors the *organic background* of 'class inference.' That is, while there is no thinking in the human sense, there is evidence of a neural complex which controls motor behavior in a rather effective way toward 'a class of similars.' This means that we have the *neural mechanism for class inference, or the neural mechanism of the concept, already present and at work at pre-thinking levels*. There is no evidence that the behavior is consciously appreciated, but on the contrary there is much evidence in the general behavior and the distribution of error that it is purely motor. The behavior is, however, *conceptual in the motor sense*. It is a more or less discursive repertoire of behavior toward classes of similars. Our present problem becomes clearer

with this discovery. It is to discover the difference between this behavior of the *motor* concept and that of the *intellectual* concept.

But there is a still higher type of motor learning to which we should now turn. We have called it the '*organic judgment.*' Let us see it in action: "One of two dogs, the larger, had a bone and when he had left it, the smaller dog went to take it; the larger one growled and the smaller one retired to a corner. Shortly afterwards the larger dog went out; but the other did not appear to notice this, and at any rate did not move. A few minutes later the larger dog was heard to bark out-of-doors; the little dog then, without a moment's hesitation, went straight to the bone and took it."[1]

Here is behavior which not only involves classes of 'objects' but shows learned connections (in the organic sense) between *similar relations* among classes of objects. In the example above there is a connection between the relation 'bone at such a place is wanted' and 'big dog out-of-doors is at a safe distance.' If we were to put the behavior into intelligent human terms for the little dog it would be shaped somewhat as follows: "I want that bone from which the big dog drove me, and now that he is safely out-of-doors, I may go and take it." There is, however, no need to assume upon the part of the little dog any appreciation of all this and there is much against doing so. We may very well substitute for this description in terms of *thought and telic aim* an explanation on the basis of the *stamped-in effects of motor experience and functional end.* This is done in the same manner as that followed in the discussion of the 'organic concept' above. The 'organic judgment' is made up from functional 'set' and the relative constancy of factors in the relations existing between classes of objects.

This final type of motor learning reveals organic connections between both the *high points* (objects) of experience and between the *paths which represent relations among them* with reference to adjustment. But here again the connections are

[1] Hobhouse, 'The Evolution of Mind,' p. 264, quoted from Morgan, 'Comparative Psychology,' p. 300.

by no means mere one-to-one associations. There has been built up by growing experience with classes of objects and their relations a repertoire of behavior which shows some discursiveness and therefore reveals that a generalizing process has been going on. The complex upon which this highest behavior is based seems to have as it were a fixed spine, and articulated to this are connections and groups of connections, so that the particular stimulations of any given environmental problem release the constant factors of behavior and select out from the repertoire of accumulated experience the particular behavior which the particular problem demands.[1] Sometimes the resulting adaptation shows a rather nice discrimination and a smooth and flexible behavior. This behavior is accounted for by the same two primary factors, the *stamped-in effects of past experience and the synthesizing process of the living tissue*, or what is sometimes called the discriminatory action of the central system.

That is to say: There is in this behavior more than association and the retention of the effects of experience and its projection into behavior. This does not account for the generalized character of the adaptations. With increasing experience we find increasing skill in dealing with classes of similars—both objects and relations—despite differences that occur. This could hardly be accounted for by the mere retention of experience. Rather a generalizing process has been going on in the neural centers. The discriminatory elements of the adaptation come from an integrative process on the

[1] It should be kept in mind that '*organic set*' *is the most primary fact of adaptation.* Adaptive reaction is not merely a matter of '*stimulus and response*' as some would have us think. The house-broke dog in the first illustrations does not break into a running-search merely because of the sensory stimuli but because he has the 'follow-my-master set.' So also in the second illustration the 'set for food' is the fundamental fact. This 'set' is resolved for the moment by fear through the growl of the larger dog into the 'protective set.' The bark of the big dog outside again releases the organic 'food set' which in turn releases the secondary motor set to go and get the bone. A *synthetic functional set* presides over stimulus-response reactions and so builds up (upon experience by the 'stamping-in' process) the learning structure required by functional adaptation. The fact to keep always in mind is that the *organic state or set* of the organism exercises selection with reference to stimuli, both qualitatively and quantitatively, and synthesizes the stamped-in effects of response in shaping learning structure. *It is the primary fact.*

basis of the relative constancy of factors. This means that we have in the 'organic judgment' the results of a neural organization which functions in a motor way by the very same pattern as that we find in human thinking in the use of the intellectual judgment. In other words, the *neural mechanism of the judgment is present and at work at pre-thinking levels.* Our problem is this: "What is the difference between '*organic judgment,*' and '*intellectual judgment*' and what *structure or technic* accounts for the difference?"

Now the learning process is cumulative. As we move up toward higher levels we find that each successive step contains all the types below it together with that *distinctive* type which marks it off as a new advance. Accordingly we have just observed that 'organic conception' is included in 'organic judgment.' We may therefore in our final word of comparison between motor learning and 'thinking,' deal with the motor concept as it is integrated into the motor judgment. This leaves us to compare thinking with 'organic judgment.'[1] Nor should this be a difficult task. We are interested here in general comparisons and we now have our problem in its serial setting where we can get the edge of relevant distinction between 'thinking' and clearly defined organic types which lie close to it and which in human behavior are smoothly integrated with it.

It is very evident that the concept and judgment do not spring full grown from the head of human wisdom. The neural mechanism upon which these are based, in the organic sense, is present at pre-thinking levels and is doing yeoman service in adaptation. In human thinking this neural complex seems somehow to *come up to a new level of function.* It somehow comes up to conscious levels and into the sphere of

[1] The marked differences added by 'intellectual thinking' to 'motor thinking' are (1) consciousness and (2) explicitness of form. These differences appear in both the *concept* and in the *relations between concepts,* (i.e., *judgments*). In place of the motor concept we have language conception; in place of the organic judgment, the intellectual judgment. While these differences ought to be noted at both points as we have tried to do, we prefer to deal with both under the 'judgment.' The 'judgment,' whether motor or mental, *handles concepts within relations.* The consciousness and explicitness which come with 'thinking' come to both the concepts and the relations, but the process by which this is done does not appear to be two steps but one.

language-use. The *pattern* is the same general pattern of *motor habit* but it now functions in *language habits*. Of course, thinking is often applied to motor adjustment. It is not, however, motor response to unconscious learning but is *conscious response to the concepts and judgments of thought and language*.

Another fact is clear besides this difference in level between 'organic thinking' and 'mental thinking.' The organic concept and judgment remain loose and indeterminate. There is in the motor adaptation arising from them a discursive element, but it is not very marked. It is limited in scope, and the distribution of error shows that it is indefinite in application as compared with 'thinking.' In thinking, the concept becomes the *definite concrete* and the judgment the *definite relation* of language use. That is, in human thinking the 'organic concept' and the 'organic judgment' *come up to consciousness* and so doing *move on to articulate completeness*. What are mere high-points in motor learning become definite concretes—*separate entities*—in 'thinking.' The relation patterns of motor behavior in turn become in 'thinking,' definitive facts—*judgments of truth*.

These two general differences define 'thinking' fairly well as a separate problem. They are such also as to make it doubtful whether thinking could be defined significantly from any other point of view, it seems to me. They warn us that we are not seeking some *new structure of motor adjustment* when we are trying to solve the problem of thinking. We are rather seeking some *structure* which will account for *lifting the highest motor technic up to conscious thought levels* where there are definite *concretes* and clearly *defined relations*.

This means that thought moves in an *unreal* field from the pragmatic viewpoint. Thought is a '*trial*' technic; for it operates in a '*trial*' field. If this is so, its findings must always be tested to behavior or experience in the primary pragmatic sense. Such advantage as it has is in *acceleration of manipulation*. This acceleration is negotiated, it seems, by the *free field of manipulation* and the *new centers of association* furnished by conscious objects, images, and names.

We are seeking, when we try to solve the problem of thinking, for structure which is adequate to account for this *free field of conscious manipulation and the new speed of manipulation which it furnishes.* In other words, the technic we are after must be adequate not only to account for lifting the pattern of the highest motor learning up to a new level of function, but also to account for the breaking up of experience so that we have *separateness of elements* and extreme *freedom* and *discursiveness* in their movement. These two latter facts are, it seems, unknown at organic levels of learning but are commonplaces of the concepts and judgments of language habits.

Finally, then, the highest motor learning has the same basis pattern as 'thinking.' It may in fact be called '*motor*' thinking. This highest motor behavior represents habits which *handle* '*motor concepts*' *within* '*motor judgments.*' Thinking, too, is a process of *handling concepts by means of judgments.* But in the latter case the concepts and judgments are those of language. They have been lifted up from their pragmatic rooting. They are by this process abstracted out as *separate concretes* and, so separated, they are handled by the same pattern as motor thinking but with *infinite freedom and discursiveness.*

The problem of thinking is to find its *type* just as we found the *types* of successive steps of motor learning. This means that we seek a *technic* adequate to account for these distinctive differences between 'organic thinking' and human 'thinking.'

CATTLE, AND EXCITEMENT FROM BLOOD

BY G. M. STRATTON

University of California

That cattle react powerfully and perhaps instinctively to blood is widely believed; and, if true, would be of important bearing upon current discussion in psychology. Accordingly it has seemed of interest to subject this belief to experiment and to compare the experimental evidence with the testimony of persons long familiar with cattle.[1]

Those experienced with cattle in California are as strongly convinced that a powerful excitement comes from *blood* as that no excitement comes of *red*.[2] The following will serve as examples of the statements which have been received from cattlemen in reply to my enquiring upon this point.

"The smell of blood," writes one, "always excites cattle of either sex, causing them to bawl, paw the ground, and also horn the ground. I have not observed that the kind of blood makes any difference."

Another writes: "Nothing else will so irritate or excite a herd as the smell of blood or the presence of a dead animal in a field or corral."

"A year ago," writes a third, "it was necessary to kill one of my horses in a pasture where the cattle were. Although considerable blood was let, it did not appear to excite the bull or cows to any extent. This summer a cow was butchered in the pasture, with the result that the bull was greatly excited for several days, and the cows somewhat less so. At various times during the day the bull would bellow and gallop, tail in air, to the scene of the killing, followed by the rest of

[1] The larger investigation, of which this is a minor part, has been aided by a grant recommended by the Board of Research of the University of California. Acknowledgment of assistance is also due to my colleague, Mr. G. H. Hart, Associate Professor of Veterinary Science; and to Dr. Beulah M. Morrison, my Research Assistant.

[2] See a preceding article by the present writer, entitled 'Red, and the Anger of Cattle,' PSYCHOL REV., 1923, 30, 321–325.

the herd. The bull evidently was the most affected by the smell. The herd would disperse after a war dance."

And from a fourth: "A freshly dehorned cow with bleeding horns seems to excite the other cattle; they are apt to follow her and appear to be somewhat afraid and suspicious and yet show a tendency to fight her. I dehorned a few cows near a pen containing a grown bull. He certainly became excited and acted as though he wanted to fight. It took a week or more for him to quiet down to his former condition."

Of the 63 cattlemen who were ready upon this point to express an opinion from their own experience, all give evidence that the smell of blood causes *excitement* among cattle.

As to the kind of excitement, they are far less clear. Less than one half of them are willing to call it *anger* or *fighting*. Three of my informants have noticed what they prefer to call *fear*. One correspondent speaks of *aversion;* another, of *curiosity*.

With regard to the effect of different kinds of blood, thirteen of my informants believe that cattle are excited by blood from their own species more intensely than by the blood of horses or sheep or swine. Twenty-four, however, do not believe that the kind of blood makes any difference.

From these reports it would thus seem clear that blood has some marked emotional effect. Yet it remains doubtful, (1) whether the effect is anger or some other emotion; (2) whether and to what extent it is caused by the odor or by the color of blood; and (3) whether cattle are more excited by blood from their own kind.

To dispel, if possible, these doubts, experiments were tried upon cattle in the Berkeley Hills, cattle that months earlier had served our experiments with color. Other cattle that we had not previously experimented on were also included. We used both cow's and horse's blood, of course separately (a week apart)—used these when freshly drawn and also a day later, but always defibrinated and fluid, the shreds of fibrin, however, being replaced in the blood. In a few instances the blood was presented in an open vessel or upon a board; but usually i was poured upon several thick-

nesses of white cloth, giving an exposed surface of 15 by 22 inches, wet and crimson—the blood being renewed from time to time—over the whole extent. This cloth, fastened to a larger piece of brown burlap about 20 by 34 inches, was commonly spread out upon the ground, crimson up, near or among the cattle. From caution, before applying the blood, the cloths singly and together were presented to some of the cattle, evoking signs of mild interest, of mild suspicion, but no more.

The experiments proved more exciting to the experimenters than to the cattle, bringing to me, at least, a complete surprise. The following will illustrate the reactions obtained.

And first with regard to horse's blood. An open quart-jar of the freshly-drawn blood was placed behind stanchions near and to windward of a 5-year bull. With his nose about three feet from it, the bull gave no sign of interest in it, much less of strong excitement.

Placed in the midst of a dairy herd of 25 cows in a corral of perhaps half an acre, and scattered in groups, two of the cows sniffed the blood for about half a minute and then remained quiet. The rest of the herd stood or lay at peace, chewing their cuds. Set to windward of another group in this herd, two looked at the blood intently; one of them smelt of it for about 30 seconds, then lifted her head quietly and looked away. The others paid no attention to the blood. Next, with the burlap so held by the corners that the crimson cloth was hidden within, while yet the blood came wet through the burlap here and there in dark spots of neutral color, I very gradually (all the while to windward) brought the whole to within about 2 feet of the cow's nose, she lying on the ground. She then arose and walked quietly away without other sign than a heavy breathing or two, perhaps only from her effort in rising.

With a heifer calf, 7 weeks old and by herself, there was intent sniffing of the burlap, with the bloody cloth within; but there was almost equal interest in my coat, my trousers, puttees, shoes. When the blood was spread open on the ground, the calf pricked up her ears, approached, sniffed it

for about 5 seconds, then came to me who stood some 4 feet away, and continued long to sniff me.

A herd of 5 heifers and a bullock, two-year-olds, all brought from the range 3 months before and placed in an extensive hill-pasture more remote than that of the dairy herd—to these wilder cattle I could not at once bring the blood nearer than 50 or 75 feet and to windward. Then urged gently toward it, some approached it with suspicion. One of these makes a slight start backward, then stands and looks. Others graze within 6 feet of it. The bullock which had stood motionless in the rear now walks rapidly to the blood and smells of it long. Then there is a start by several, but with no sound save from their sniffing. The bullock now licks the blood, raises his head and all stand quiet. Again there is a slight start, several backing a step or two, and then a return to the blood again and again. Three of the heifers are soon grazing near by; and within perhaps 10 minutes from his first attention, the bullock stands quietly by the blood, no longer interested in it.

In another herd and still another the experiment was varied by strewing over the blood fresh grass or straw, until the blood and cloths were completely hidden from sight; and then, again, exposing the bloody cloth to full view. Over the spot of the concealed blood some of the herd that came near would stop and sniff, head down for a moment. To the blood in full view was given a greater interest.

We may turn now to the effect of *cow's* blood instead of horse's, freshly drawn, a week later. When an open quart-jar of the fresh blood was pushed near to the manger of the 5-year bull by Miss Morrison and within a few feet of his nose while eating, he sniffed and bellowed; and a like reaction came when some of the fresh blood was spread upon a board and placed on the rim of his manger.[1]

The board with the fresh cow's blood now placed among

[1] In comparing this reaction with that to horse's blood by this same bull and to cow's blood 24 hours later, it should perhaps be said that the particular place where the fresh cow's blood was presented may have contributed to the effect. The manager of the dairy, Mr. Stroud, has found the bull especially resentful of disturbance there. Further experiments, it is hoped, will clear up this doubt.

the dairy herd, group by group, caused those nearest to sniff it, and at times to back off; but they soon lost all interest. While the bull, as we have just seen, gave a more violent response to the cow's blood than to the horse's, the reaction of these cows to the fresh cow's blood was not noticeably different from their reaction to the horse's blood 24 hours old.

The next day, with the cow's blood now 24 hours old and spread, as the horse's blood had been, plentifully upon a like-sized mass of white on burlap, the 5-year bull—the bloody cloth spread upon the ground in his open pen—sniffed it for some seconds, walked unexcitedly off, came back and sniffed. Thereafter on being urged gently past the blood, he showed some slight avoidance of it.

A heifer calf, now 8-weeks old, showed a like mild interest, with perhaps some avoidance.

The dairy herd of about 25 cows—the herd to which the fresh blood had been presented the day before—today showed mild interest, with licking of the blood by some of the cows. But most of the cows lay around listless. Yet those near and that did show interest clearly showed more interest than they had in the horse's blood.

On the other hand the wilder herd farther in the hills that had shown some mild excitement over the horse's blood had far less interest in the cow's blood. But they were now in a 'tamer' region, where they had been accustomed to see more passers-by. Here the bullock merely nosed the blood, sniffing; and within 2 minutes he stood over it, sidewise, wholly inattentive.

And a similar mild reaction we had from another and far larger herd in a wooded dell of the hills.

In general the observations might be summed up as follows:

1. There was little of that excitement which reports of our cattlemen would lead one to expect. There never was any pawing of the ground, never any horning of the ground, never any running about. There was no herd-seizure of alarm or rage. The general absence of response by the herd as a whole was striking: usually the animals came singly to the blood,

sniffed it, satisfied their curiosity, lost interest, and stood by in apathy or passed on. In only one case was there any bellowing,—when a bull was disturbed in his manger while eating. Save in this, there was nothing like anger; and here we may doubt whether the response was due to the blood alone or to this conjoined with disturbance in what he may have regarded as something like his proprietary rights and by a strange and inexcusable creature, a woman! Blood of itself was usually not anger-provoking, and not even strongly exciting.

2. The blood caused curiosity mingled with distrust or mildest fear. There was some aversion or avoidance, but also some liking for it, when both horse's and cow's blood was licked by some.

3. The odor of blood seems to be less exciting than is the odor and sight of it combined; and (judging from the experiments on color and from the action toward neutral-hued or dark brown blood on burlap as against crimson blood on white) the effect of the sight of blood is due less to its hue than to its brightness. Our experiments do not support the idea that there is some peculiar prepotency in the *smell* of blood. The *look* of the blood, if bright, seems worthy of at least an equal place with the odor.

4. To blood of their own kind the reaction may be less or more than to the blood of the horse, but according to conditions. To our own nostrils the cow's blood was more pungent and disagreeable than the horse's blood; this may help to explain the stronger effect, when it occurred.

5. There is no clearly greater effect from blood freshly drawn than from blood kept cool and closely covered for a day. Now the one and now the other seemed more potent.

6. The licking of the blood, both of horse and cow, by several of the cattle is of interest, and would indicate how small is the repugnance or fear which blood of itself may awaken.

How shall one explain the variance of our observations from those of cattlemen, especially when so commonly they report intense herd-excitement?

Of the accuracy of their account of fact I make no slightest

question,—although I reserve a word upon their interpretation. It may be that in the blood-experiments but not in those on color, our cattle responded only as do those of the tamer sort, and that out upon the range the reaction to blood is characteristically different. Upon that, I hope in due time to have experimental evidence. Yet in the meanwhile I attach no great weight to such a doubt. For on the whole the animals closest to men—the dairy herd and the 5-year bull—gave the strongest reaction to blood; those cattle less tame and more remote were not the livelier in their response.

The intense excitement observed by cattlemen I venture to think may after all be due, not to blood alone, but to blood in union with other factors: with the cries of cattle in pain or in alarm or rage; with the sight of wounded or prostrate cattle, living or dead; with the effect of human treatment already tending toward fear or rage; or with the scent, or other clue of animals that cause fear or rage in cattle. In many of their reports to me, as in the examples I have given, these various factors are inextricably confused. And in the herd observed by Hudson in South America, when the cattle came up the wind to where the blood was on the ground, and showed great herd-excitement,[1] it may be that Hudson is wrong in surmising that some thieving *gaucho* had done the killing; the killing may have been by some feral enemy, and the signs have still been there for the cattle. Or in such herds, perhaps accustomed to defense against attack by beasts, there may well have developed herd 'traditions,' herd-habits of reaction to shed blood, which come from their special experience. Our own experiments, reasonably free as they are from these interfering or intensifying influences, perhaps better reveal the native effect of blood, pure and simple.

If this surmise be correct, it means that the reaction of cattle to blood is far less a native physiological reaction than is commonly thought. But in any event we may hereafter feel far less assured that the profound reaction of men and animals to blood is really what James calls it, namely a 'fatal reflex response.'[2] Nor am I persuaded by his boyhood's ex-

[1] 'A Naturalist in La Plata,' 1903, 331 f.

[2] 'Principles of Psychology,' II, 414.

perience of fainting while stirring a bucket of blood, which he uses in support of his theory of emotion.[1] He believes that his feeling until the moment of fainting was wholly of curiosity. But I doubt that a child of his age and alertness could have escaped the common human associations of blood with wounds and suffering. In the main, I incline to think, the powerful effect of blood, which is indubitable, is not its immediate and natively physiological effect; but comes in large part from the individual's or the herd's experience, from its psychic implications of pain, hostility, and active defense.

The present observations accordingly bear upon the current discussion of instinct, tending to remove one highly complex reaction from among those that may rightly be counted innate; and to place it among those where special experience is important. The observations bear also upon the James-Lange theory, insofar as they tend to weaken the evidence, at one point, that an innate physiological response itself brings on the emotion. In this instance of ours, at least, it seems untrue that cattle feel fear or rage at blood *because* it profoundly affects them reflexly. The rather it would seem that the profound response to blood appears only when the animal, *upon other grounds*, is already stirred to some degree of fear or rage.

[1] 'Principles of Psychology,' II, 457.

A COMPARISON OF THE INTELLIGENCE OF MEXICAN AND MIXED AND FULL BLOOD INDIAN CHILDREN[1]

BY THOMAS R. GARTH

University of Denver

Of many principles of genetics we must be ever mindful in investigations of race psychology, but in the present experimental problem we would test out: First, the principle that like begets like, so that its mental product—here intelligence—tends to be different from the product of other origins;[2] Second, the principle that isolation of groups brings about differences in intelligence; Third, the principle that mixture of different lines brings about differences in intelligence as measured;[3] Fourth, the principle, which is an anthropological one, that nomadic peoples, because of the rigorous play of the law of natural selection, are more intelligent than sedentary peoples. Finally, we wish to arrange the blood groups which we are considering, *i.e.* Mexicans, mixed-blood Indians (composed of individuals having white and Indian ancestry, the latter being descendants of the Plains and Southeastern Indians in this case), full-blood Plains and Southeastern Indians (descendants of tribes of nomadic habits), full-blood Navajo and Apache tribes (likewise of nomadic ancestry but of habits somewhat different from that of the foregoing group), and full-blood Pueblo tribes (having ancestry with sedentary habits) in a series on an accepted scale for the measurement of intelligence in use in testing white children, *i.e.* the National Intelligence Test—Scale A.

In all experimental studies of this sort it is the obligation

[1] Paper read before the American Psychological Association at Cambridge, Mass., December 29, 1922. A preliminary report of this experiment appeared in *Science*, 56, 635–636.

[2] E. L. Thorndike, 'Educational Psychology,' Vol. 3, p. 250.

[3] E. L. Thorndike, *ibid.*, p. 264.

of the experimenter to endeavor to measure the behavior of such somatic tendencies producing mind as may be alone due to tendencies peculiar to racial germ cells and not to environmental influences alone. If he was not able after strenuous effort to control all other factors so that the result may be said to be a measure of behavior due to the influence of germ plasm, no desire on his part to make a clean-cut statement should induce him to hasten to draw conclusions relative to race differences.

The Subjects of the Experiment

We have for study behavior due to the influence of germ plasm on somatic behavior of three full-blood Indian groups, two of them of nomadic ancestry; that is, first, a group of Plains and Southeastern Indians; second, a group of Navajo and Apache Indians; and we have one of sedentary ancestry; that is, third, a group of Pueblo Indians. A fourth group is of mixed-blood Indians representing a mixture of germ plasm of whites and Plains and Southeastern Indians. Group five is composed of Mexicans, representing the typical 'Mexican' whose ancestry is largely of Spanish blood and of various—probably all—nomadic tribes of Mexico.

We were obliged to take the statements of the Indian subjects as to degree of Indian blood, as *full* or *mixed*, since there were at hand no means for us to determine this by anthropometric measures. Such figures are taken at their face value by the United States Government in the absence of better determination of amount of blood.

When the tests were given to the Mexican children, the experimenter likewise took at its face value the classification of the white teachers of the several schools who said that they knew the subjects to be Mexicans. As it was, most of the subjects themselves claimed to be Mexicans, though four said they were of Italian and Mexican parentage, four of Irish and Mexican, two of French and Mexican, two of Danish and Mexican, and one of English and Mexican parentage. In all these cases but one, the mothers were said to be Mexicans. We should say, however, that the term Mexican as

used here is rather hard to define. At least we believe that it signifies the mixture of Spanish with Mexican Indian (of nomadic habits) germ plasm, with the few exceptions mentioned. To be sure this means that we are taking the reports at their face value and they appear to be correct.

The Test and Its Administration [1]

The tests used in the experiment were the National Intelligence Tests, Scale A, and they were administered by the writer himself, except in two instances where he observed two of his students give them to two groups of Mexicans.

The tests of the Indians were given in the United States Indian Schools at Chilocco, Oklahoma, and at Albuquerque, New Mexico, and were likewise administered by the writer personally.[2]

Handling the Data

We have handled the data looking to the solution of the following problems:

1. Do the frequencies for the measures of the groups arrange themselves with multimodality, or are the measures continuous on the scale?

2. Are there differences in central tendencies between the several groups as indicated by overlapping?

3. Are the differences consistent for all subgroups of the blood group as measured by the central tendencies?

4. Are these tendencies to differ consistent when the performances of the upper and lower ranges are compared in all subgroups of the blood groups?

[1] Acknowledgment is here made to Superintendent Jeremiah Rhodes and his assistant, Mr. W. J. Knox, for the courtesy extended the experimenter in allowing him to give the tests in the San Antonio (Texas) Schools, as well as to the various principals and their teachers who rendered especial assistance. Likewise the writer acknowledges the help of Miss Georgia Colvin, A.B., and Miss Irma Gesche, A.B., who acted as attendants in the administration of these tests at San Antonio. These tests to the Mexicans were given in the spring of 1922.

[2] The expedition to the Indian Schools in which these tests were given was financed by the Grants Committee of the American Association for the Advancement of Science, and occurred in the spring of 1921. The writer acknowledges the courtesies shown by Superintendent C. M. Blair, of the Chilocco U. S. Indian School, and Superintendent Reuben Perry, of the Albuquerque U. S. Indian School, in affording him the privilege of giving the tests to the students in their schools. In the latter school Mr. Fred Lobdell assisted in planning the testing program.

5. Which blood groups differ most?
6. Are the differences to be regarded as race differences?

The Question of Multiple Types

This question will be answered by examining the distribution surfaces for the blood groups. Because many of the blood groups are small we have been compelled to combine the age and sex groups, so that we have of Mexicans 307 cases; mixed-blood Indians 126; Plains and Southeastern full-blood Indians 176; Pueblo full-blood Indians 249; Navajo and Apache full-blood 85. Whether or not our data when arranged in five frequency distributions indicates in single instances multimodality may be seen by an examination of the curves representing the distributions themselves, as shown in Fig. 1*a*. It will be seen here that the scores of

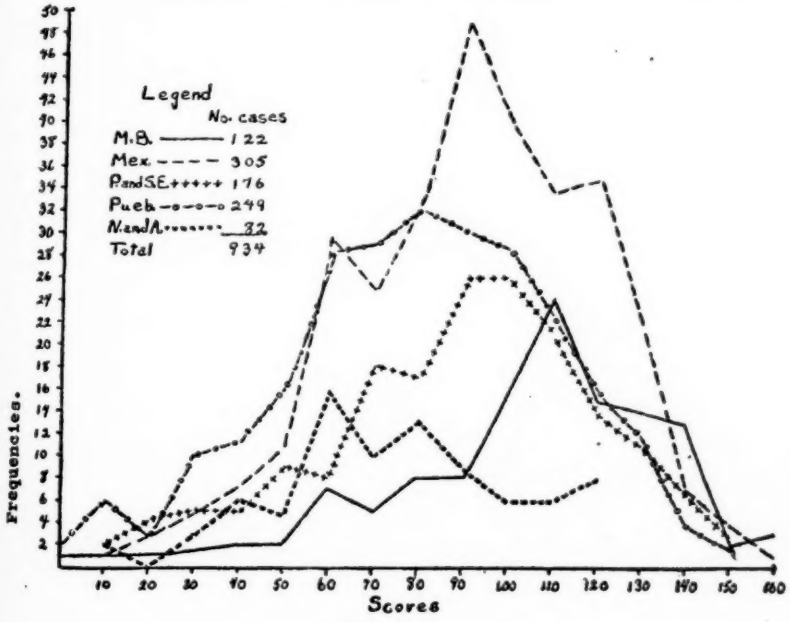

Fig. 1*a*

each of the blood groups tend to cluster around single central

tendencies, though the distribution surfaces are not absolutely symmetrical. The greatest disposition toward flattening is shown by the pure-blood groups—the Plains and Southeastern group and the Pueblo group. We may ignore the appearance of the Navajo and Apache group because of its small number, 85. But in the mixed-blood group, where we would expect to find bimodality, it does not appear. However, the Mexican group shows some indication of multimodality because of the two small subsidiary peaks. Even so they are only slight and but for the largeness of the groups and homogeneity as to age of the subjects (12–16 years), might be ignored. But we cannot think this multimodal tendency here indicated is necessarily due to diversity of germ cells, because if the curve here shown were broken into three smaller curves based on age, only one of these, the curve for the 12–13 year olds, shows the multimodality. The others represented are fairly symmetrical.

The answer, then, to the question as to the multimodality would seem to be a negative one; that is, each group whether mixed or full-blood tends to have a single central tendency.

Group Differences and Score Sequences

The classification of the subgroups of the blood groups has been made on the basis of age. The ages run from 12 to 19 years. Because these numbers for a single age were too small it was necessary to combine the age subgroups, and even then some of the subgroups are all too small. Table I. gives the number of cases, average score, median, and percent of any age subgroups attaining the median score of the Plains and Southeastern respective age subgroups.

It will be seen that always the central tendencies of the mixed-blood scores are highest; that on the same base of determining, the Mexicans invariably come second; the Plains and Southeastern full-bloods come third; the Pueblo or Plateau full-bloods come fourth, except in the last, 18–19 years subgroups, when the Navajo and Apache scores are slightly superior. The central tendencies of scores for the last named group, the Navajo and Apache, but for the small-

ness of the groups, would indicate that they are the least intelligent, as indicated by these tests, of all the blood groups. See Table I.

TABLE I

THE RELATIVE INTELLIGENCE OF INDIANS OF NOMADIC AND SEDENTARY TRIBES AND MIXED BLOOD INDIANS

The scores are of the National Intelligence Tests, Scale A, Form 1.

	No. Cases	Score Median	% attaining median of Pl. & S. E.	Average Score	P. E.
12 and 13 years:					
Mixed Bloods	15	103	80%	83.6	12.6
Mexicans	145	85	60	81.7	19.2
Plains and S. E.	8	76	—	74.8	—
Pueblo	46	64	40	68.8	5.24
Navajo and Apache	12	52	10	57.8	13.2
14 and 15 years:					
Mixed Bloods	30	110	80	93.9	15.1
Mexicans	132	92	70	91.5	17.9
Plains and S. E.	55	85	—	85.2	20.5
Pueblo	82	80	44	79.4	18.6
Navajo and Apache	19	60	20	66.3	18.7
16 and 17 years:					
Mixed Bloods	41	104	71	96.9	14.4
Mexicans	28	91	54	92.3	15.3
Plains and S. E.	60	90	—	87.3	18.5
Pueblo	95	78	34	78	21.2
Navajo and Apache	30	77	23	76.2	19.1
18 and 19 years:					
Mixed Bloods	31	114	60	101.6	19.9
Mexicans	2	—	—	—	—
Plains and S. E.	53	88	—	81.4	19.8
Pueblo	26	71	30	70	22.7
Navajo and Apache	24	77	40	75.3	18.6

The tests for a difference as indicated by the overlapping, using the median scores of the Plains and Southeastern age subgroups as a base, indicate that these differences are real differences generally, except in the case of the Plains and Southeastern and Pueblo full-bloods where the differences only tend to be real in favor of the former. Moreover, the differences seem to grow less secure as the ages of the subgroups increase, in the case of all but the Pueblos, who lose somewhat by this comparison, for the older Pueblo Indians seem to be less intelligent, as thus indicated, than the younger ones when brought into comparison with Plains and Southeastern

Indian intelligence as measured. On the other hand, the Navajos and Apaches gain. The facts are very well represented by the percentile charts which show graphically the above mentioned sequences. See Figs. 1*b*, 2, 3, 4.

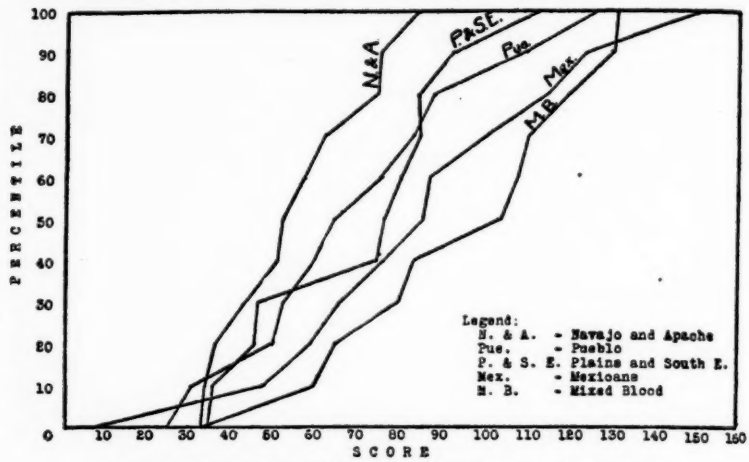

FIG. 1*b*. Percentile chart for N. I. T., Scale A. 12 and 13 years.

If we take the overlapping of a subgroup on the Plains and Southeastern median as the index of a difference, the

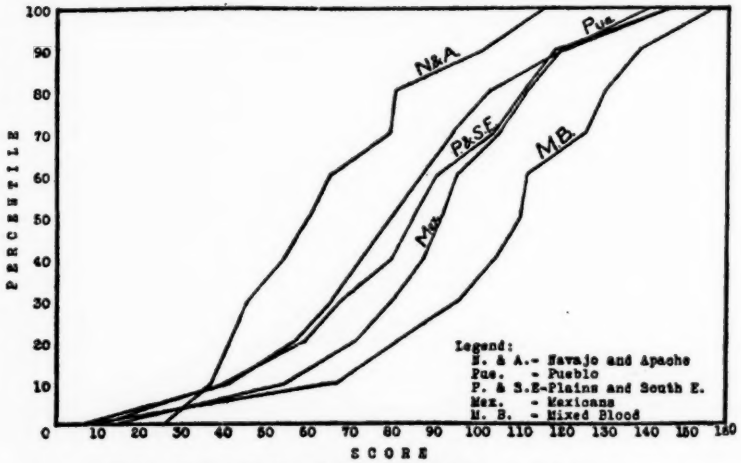

FIG. 2. Percentile chart for N. I. T., Scale A. 14 and 15 years.

figures of the table show that these measures are just about as great when we compare Mexicans and Plains and Southeastern blood groups, as when we compare Plains and South-

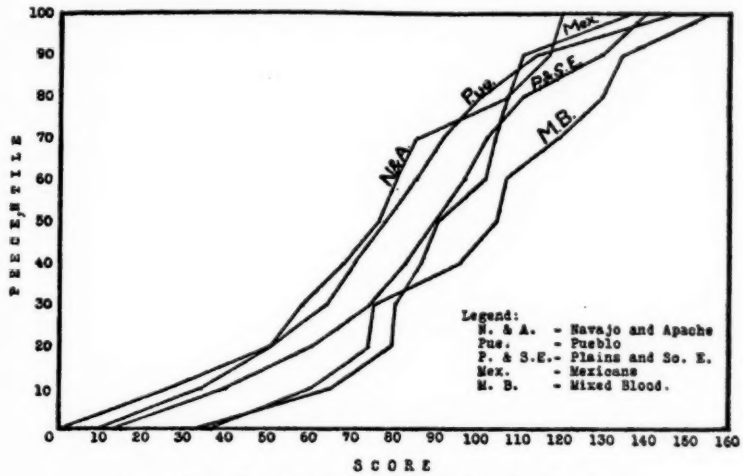

FIG. 3. Percentile chart for N. I. T., Scale A. 16 and 17 years.

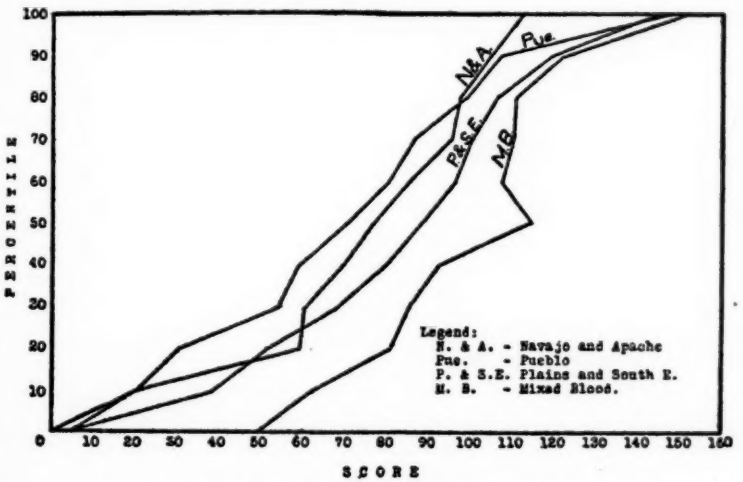

FIG. 4. Percentile chart for N. I. T., Scale A. 18 and 19 years.

eastern and Pueblo subgroups. That is, there is not quite as much difference between Mexicans and nomadic Indians as there is between the latter and the sedentary Indians. In both cases the differences tend to be real. If the number of cases of the Navajo and Apache subgroups were larger we might hazard some similar conclusions. Here the measures of overlapping show them to stand below the Pueblo Indians.

Upper and Lower Percentiles

An examination of the scores in the upper and lower percentiles, as represented in Table II. in the percentile graphs, indicates less of difference than is found in a comparison of the interquartile ranges. This is what would be found presumably in the comparison of any groups measured by a similar device. It appears that the most intelligent individuals in the several groups are more alike than the representative or average individuals, and even so may this be said of the least intelligent ones. However, the sequence as indicated by comparing median and averages holds fairly well in these groups upon comparing upper and lower percentile scores.

Table II

Showing Percentile Score for Age Groups
National Intelligence Test
Scale A

12 and 13 years

	No. Cases	Scores										
Navajo and Apache.....	12	32	33	36	43	51	52	57	62	74	75	84
Pueblo.....	46	24	30	44	52	59	64	75	83	88	109	126
Plains and S. E.....	8	34	35	45	46	74	76	80	84	84	92	112
Mexicans.....	145	7	47	58	65	76	85	87	100	114	123	152
Mixed Bloods.....	15	32	58	64	79	83	103	107	110	119	129	131
	Percentile	0	10	20	30	40	50	60	70	80	90	100

14 and 15 years

	No. Cases	Scores										
Navajo and Apache.....	19	26	37	42	46	54	60	65	79	81	102	116
Pueblo.....	82	6	42	57	66	73	80	88	94	103	121	141
Plains and S. E.....	55	12	40	58	67	80	85	91	104	111	118	146
Mexicans.....	132	15	54	72	80	87	92	95	105	112	120	146
Mixed Bloods.....	30	10	67	82	96	104	110	112	126	130	138	156
	Percentile	0	10	20	30	40	50	60	70	80	90	100

16 and 17 years

	No. Cases	Scores										
Navajo and Apache	30	9	34	51	58	68	77	81	86	107	117	120
Pueblo	95	0	26	51	64	71	78	86	92	101	114	147
Plains and S. E.	60	13	40	61	74	83	90	97	102	111	129	140
Mexicans	28	33	65	79	81	87	91	102	104	107	111	137
Mixed Bloods	41	36	60	74	76	96	104	107	119	129	134	156
	Percentile	0	10	20	30	40	50	60	70	80	90	100

18 and 19 years

	No. Cases	Scores										
Navajo	24	4	21	59	61	70	77	86	95	97	109	112
Pueblo	26	0	21	31	54	59	71	61	87	98	107	147
Plains and S. E.	53	3	38	52	68	80	88	96	100	106	119	145
Mexicans	2	—	—	—	—	—	—	—	—	—	—	—
Mixed Bloods	31	49	63	82	86	93	114	107	110	111	122	151
	Percentile	0	10	20	30	40	50	60	70	80	90	100

The Differences Measured

Table III. shows the median score of any blood subgroup expressed as a percent of the median score of the respective Plains and Southeastern subgroup. It will be seen that on the average the mixed-blood median score is 27 percent better than that of the Plains and Southeastern median scores; the Mexican 7 percent better, on the average; the Pueblo 14 percent poorer and the Navajo and Apache 23 percent poorer on the average.

Table III

Median Intelligence Scores for Subgroups Expressed as Percentage of Respective Plains and Southeastern Medians

Subgroup Age	Mixed Blood %	Mexican %	Plains and Southeastern %	Pueblo %	Navajo and Apache %
12–13	135	112	100	84	68
14–15	129	108	100	94	70
16–17	115	101	100	86	85
18–19	128	—	100	81	87
Average %	127	107		86	77

Social Status and Education

Any conclusions which may be here reached must be made in the light of the facts of nurture, or modification of

native tendencies. School children in the United States Indian Schools were selected for the reason that it was desired to control the factors of education and training as far as possible.

Table IV. shows the amount of school education of each of the age subgroups. On the whole the blood group having the most school training is seen to be that of the mixed-blood;

TABLE IV

SHOWING AVERAGE AMOUNT OF SCHOOL ATTAINMENT

Subgroup	12–13 yrs.	14–15 yrs.	16–17 yrs.	18–19 yrs.	Average
Mixed Bloods	5.1 yrs.	6.0 yrs.	6.4 yrs.	6.8 yrs.	6.1 yrs.
Mexicans	5.3 "	5.9 "	6.3 "	0.0 "	5.9 "
Plains and S. E.	4.6 "	5.6 "	5.6 "	5.9 "	5.4 "
Pueblos	4.8 "	5.7 "	6.4 "	6.3 "	5.8 "
Navajo and Apache	4.8 "	4.7 "	5.2 "	6.3 "	5.2 "

next or second, the Mexicans; third, the Pueblo Indian; fourth, the Plains and Southeastern group; and fifth, Navajo and Apache. As to social status we shall have to depend on expert opinion alone which is given merely as a general impression after much experience in working with Indian schools. We quote here a statement of Superintendent C. M. Blair, of the United States Indian School of Chilocco, Oklahoma.

He says: "1. I think there is no question but that the presence of a child in the home where one parent is white will influence the child to behave more as a white man behaves. It is simply a question of the influence of environment. In the full-blood home the atmosphere of the home is more backward and less influenced by the white civilization.

"2. The mixed-blood has more opportunities to learn English in the home because the English language is used to a greater extent than the Indian language. In the full-blood home, generally speaking, the Indian language is used to a considerable extent even though the parents may be well educated, just as in the home of the Swede or German the old mother-tongue is used to a considerable extent. Therefore, I would say that a mixed-blood has a better opportunity to learn the English language than a full-blood by reason of the difference in the home.

"3. There is no question but that the Oklahoma Indian has been more closely associated with white civilization than the Pueblo Indian, and is more familiar with white ways and the English language. His contact with the white has been of longer duration and more intimate.

"4. The Navajo and Apache are both farther removed, in my judgment, from the white influence than the Pueblo. The Pueblo lives along the Rio Grande valley in New Mexico, which has attracted white people more strongly than the mesas and desert country which is the home of the Navajo and Apache. Therefore the large reservations on which we find the Navajos and Apaches have very little contact with the white and are consequently not so much influenced as to habits and language as the Pueblo. Also the Navajos and Apaches have stronger characters naturally than the Pueblos and do not assimilate the white civilization as readily. The Navajo, to my mind, is the finest Indian unspoiled in our life today. He has been working out his living for centuries and, for him, making a success of it.

"5. It is more legitimate to compare the Pueblo with the Mexican as a mixed-blood than with ordinary mixed-bloods of Oklahoma. The Pueblo speaks Spanish and his mode of living is very similar to that of the Mexican. However, the Pueblo is not very fond of the Mexican and there are many differences in characteristics."

In view of this statement which we believe gives the facts as to social status in a rather trustworthy way, we may say then—recognizing that the Mexican is a mixed-blood individual from a home in which Spanish is the language largely spoken—the social status of the mixed-blood is the most superior of all the blood-groups; second, come the Mexicans; third, the Plains and Southeastern Indians; fourth, the Pueblo; and fifth, the Navajo and Apache groups. It will be noted, however, that the Pueblo blood-groups have had more schooling than the Plains and Southeastern Indians and this seems to offset somewhat the latter's better social status.

There are two other studies of intelligence of Indians in

the literature of racial psychology to date: one by E. C. Rowe, who gave Binet-Simon individual tests to 268 Indian children and found that 94.2 percent tested below age, 4.6 percent at age, and 1.2 percent above age, making no allowance in these figures for social status.[1] The other study is by Walter S. Hunter, who, assisted by Eloise Sommermier,[2] investigated the relative intelligence of Indians of different degrees of Indian blood and of whites with the Otis Intelligence Test. They found a positive correlation between degree of white blood and intelligence score. As in the case of Rowe's study and of the present study, it was impossible to secure figures measuring the social status. However, Hunter is of the opinion that "Inferior social status may well be the result of low intelligence rather than its partial cause."[3]

Age–Grade Comparison

In an experiment of this sort it would be desirable, in order to control all possible factors except the one to be measured, to make an age-grade comparison. We have not been able as yet to do this with any satisfaction as to conclusiveness of results.

Summary

1. In the distribution surface we find unimodality to be the general rule even in the case of the mixed-blood groups. Finer measures might bring to light multimodality in these cases.

2. The measure of intelligence indicates the following sequence: first, mixed-bloods; second, Mexicans; third, Plains and Southeastern Indians; fourth, Pueblo Indians; fifth, Navajo and Apache Indians. The ratios are respectively: 127, 107, 100, 88, 77, using Plains and Southeastern Indians as the base.

3. Estimates of social status indicate the same sequence as the foregoing.

4. The average amount of education of the blood groups

[1] E. C. Rowe, 'Five Hundred Forty-Seven White and Two Hundred Sixty-Eight Indian Children Tested by the Binet-Simon Tests,' *Ped. Sem.*, 1914, 21, 454–468.

[2] Walter S. Hunter assisted by Eloise Sommermier, 'The Relation of Degree of Indian Blood to Score on the Otis Intelligence Test,' *J. of Comp. Psychol.*, 1922, 2, 257–275.

[3] *Ibid.*, p. 274.

runs in the same sequence except that the Pueblo Indians have slightly more of this than the Plains and Southeastern Indians.

5. The mixed breeds excel the pure breeds in intelligence scores.

6. The scores of those individuals of nomadic tribes excel those of sedentary tribes.

7. If these groups may be taken as representative of their racial stocks, the results indicate differences between their racial stocks in intelligence as here measured.

8. Because of the fact that social status and education have not been controlled, we may not positively state that these data indicate innate racial differences in intelligence, but one is inclined to believe that differences in opportunity and in mental attitude toward the white man's way of thinking and living are here made apparent. In some schools the latter is taken as indicative of degree of intelligence according as to whether the attitude is positive, indifferent, or actually negative.

DISCUSSION

FRANK'S SUGGESTION FOR A THEORY OF LEARNING

Recently, in connection with brief remarks on certain theories of learning evaluated by Kuo, I made the statement that the problem of how erroneous acts are eliminated in the learning process is probably one of the most important in psychology today.[1] As a consequence of this statement Frank[2] has offered a suggestion toward a theory of learning, which shows the usual neglect of the really essential aspects of the problem. He suggests the 'conditioned reflex process' as the sufficient principle. Aside from the fact that he regards this as a new and recent addition to psychology, he avoids the vital problem of the elimination of wrong acts that have occurred in a series leading up to a solution, the problem of short-circuiting. Conditioned reflex processes are clearly cases of association by contiguity, not different in principle but only in application and in method of objective experimental demonstration from the phenomena clearly pointed out by Plato and Aristotle and by many modern writers, and explained, essentially as we now explain them, by Hobbes, Descartes, Locke, Hartley, James Mill, and others. Dr. Frank applies his suggestion of conditioned reflex only to the simplest cases of elimination or inhibition of response to one of two simultaneous stimuli, and while these cases offer no trouble to any psychologist he offers only names—positive conditioned reflex and negative conditioned reflex—to account for them. His assumption of ignorance on the part of psychologists of the 'Comparative Physiology of the Brain' by Loeb, and apparently also of the principal features of the work of Pawlow, is probably due only to his own lack of acquaintance with the literature and the experiments on the psychology of learning. The theories mentioned in Kuo's article,[3] discussed in the first reference cited, include all that Frank now offers as 'food for reflection by psychologists of to-day,' and much more.

[1] Peterson, Joseph, 'A Note on Theories of Learning,' *Psychol. Bull.*, 1922, 19, 443–446.

[2] Frank, Lawrence K., 'Suggestion for a Theory of Learning,' PSYCHOL. REV., 1923, 30, 145–148.

[3] Kuo, Z. Y., 'The Nature of Unsuccessful Acts and Their Order of Elimination in Animal Learning,' *J. of Comp. Psychol.*, 1922, 2, 1–27.

While there is probably in no psychologist's mind any doubt concerning the usefulness and the many valuable applications of the work on conditioned reflexes both to general psychological science and to medical practice, there are certainly many psychologists who refuse to be satisfied by a few trivial illustrations, the explanation of which give trouble to no one, and by a final general assumption or an explicit assertion, that these cases are typical of and make clear, or even suggest, the solution of all forms of learning. Mere terms do not help us, or we might more profitably use such terms as 'conscious selection,' 'the perception of meaning,' 'attention,' 'the subconscious,' or for all cases the general term 'an animistic principle;' and the general principle involved in the conditioned reflex in its various forms is not new, as I have stated. Indeed, Locke in his 'Essay Concerning Human Understanding,' published in 1690, gives some good cases of phobia and of aversion that today would be named conditioned reflexes, and he clearly states the principle on which they are based, though he makes very little use of it in this great work. "Custom settles habits of thinking in the understanding," he says, "as well as of determining in the will, and of emotions in the body; all which seems to be but trains of motion in the animal spirits, which, once set agoing, continue in the same steps they have been used to, which, by often treading, are worn into a smooth path, and the motion in it becomes easy, and as it were natural." Wrong connections may arise in our minds and come thus to have great influence on our actions, moral natures, passions, reasonings, and motives. "A man receives a sensible injury from another" and he "never thinks on the man, but the pain and displeasure he suffered comes into his mind with it, so that he scarce distinguishes them, but has as much aversion for the one as for the other" (Bk. 2, ch. 33). This explanation is entirely satisfactory if we but substitute the modern term for 'animal spirits;' but Locke does not go to the extreme of attempting to explain all our mental adjustments in terms of this principle, or of suggesting that this is possible. He, in fact, does not use the principle of association as much as we may legitimately use it today. In the recent literature of learning, however, there are many evidences that learning, in as far as it is a process of elimination of erroneous acts in a series and not merely the establishment of simple connections between one event and another or between an act and a certain stimulus, involves inner tensions and the interaction of different part processes within the organism.

Now to come right down to vital matters, will Dr. Frank explain on the basis of his suggestion why an animal performing a series of acts, *m*, *q*, *a*, *r*, *b*, *p*, *o*, *y*, and *t* and getting food or freedom—as the case may be—with act *t*, does not continue to go through this whole series even though *q*, *a*, *b*, and *o* may be wholly useless or even 'errors,' such as entrances to blind alleys? How can his hypothesis account for the experimentally established facts that rats in a maze eliminate backward runs on emergence from blind alleys relatively very much earlier than they eliminate entrances to the blind alleys; that the animals often eliminate the latter errors by first running to the end of *culs de sac*, later nearly the full length, and gradually in successive trials enter less and less far until a final stage is reached when the rats merely show uncertain balancing movements or head vibrations, and that in such cases occasional full entrances are made after the head vibrations with the result that many other errors are made in such runs at more distant *culs de sac* which had formerly been eliminated?[1] In the latter type of cases confusions result from the one erroneous act that had nearly been eliminated, which throw the animal out of all the adjustments that had been established. How, to add just another of many complex cases, on the contiguity principle can we explain learning by human subjects in a mental maze[2] under conditions which put a negative value for the learning on frequency and recency factors as these terms are used in psychology and in the conditioned reflex literature? We need not now also take up the cases of dissociation which have caused many writers—wrongly, let us admit— to assume the influence of some subconscious entity to which they ascribe arbitrary force.

Cases like these are met on every hand when we examine in detail under carefully controlled experimental conditions the higher forms of learning. Many psychologists at once assume some peculiar power of consciousness, intelligence, perception, judgment, memory, or of some other faculty, in the old genuine sense of the term probably repudiated by them in a general way in other connections. By some writers of high authority a general 'animistic principle' is made to do the work in such cases, as if this were an explanation. This dodging of the issue leaves room for the Freudians and other pseudo-scientific writers to come in with their all-sufficient 'Unconscious.' Indeed, the assumption of an unconscious entity of

[1] Peterson, Joseph, 'The Effect of Length of Blind Alleys on Maze Learning: an Experiment on Twenty-Four White Rats,' *Behavior Monog.*, 1917, No. 15, 24 ff.

[2] Peterson, Joseph, 'Learning when Frequency and Recency Factors are Negative,' *J. Exper. Psychol.*, 1922, 5, 270–300.

some sort to explain what consciousness, also conceived as an entity with powers of controlling action, cannot account for, is only dodging the real issue by playing cleverly on a mere word. The entity whether conscious or unconscious is there, just the same, to save the difficulties and troubles of a real explanation. Why not make a clean breast of our ignorance in this whole matter, accept what little we really know with its recognized limitations, seek humbly and directly for more knowledge by the setting up of hypotheses subject to experimental test, with as little play on mere terms as possible? It matters little whose hypothesis we take if it is clearly conceived and if it fulfills the two conditions stated in my earlier note cited by Dr. Frank.

Dr. Frank has gone into this matter with the right attitude and freedom from assumptions of arbitrary faculties. It is only unfortunate that he does not, on the one hand, show an acquaintance with the tests that have been applied to his hypothesis so far as they have gone, and, on the other hand, attempt to carry his suggestion of the use of the old elementary principle of contiguity, so clearly stated by James in his chapter on association, as all readers will know, into the yet unexplored fields of the higher learning and rational processes where 'big game' is plentiful. It is to be hoped that we may have further serious attempts by this writer and by others on these matters which seem vital to the advance of scientific psychology. It appears to me that we must conceive some sort of hold-over effects from previous stimuli—possibly by means of back and forth reflections of impulses between sensory and motor elements in the skeletal muscles through central areas, as well as by inter-stimulation for some appreciable periods of time of various visceral and other organs—so that a situation, a succession of serial complex stimuli, rather than a mere simultaneity of stimuli, becomes effective as a unit in the control of response. Such hold-over effects of serial stimuli and responses, enabling all the impulses to be so organized that the consummatory acts may find the expression most consistent with all the circumstances (may give the completest response, practically and not absolutely, of course, to all the opposing tendencies and impulses in the organism) is what I have myself tried to state and to test out in a series of researches that have been published. There appear to be inner conflicts in the nervous system among opposing tendencies, tensions determined by a complexity of external circumstances, which finally result in the elimination of certain acts and the enhancement of others, and

which are wholly inexplicable on the simple passive association laws with which we have become acquainted in the processes called the association of ideas and conditioned reflexes. Basic to these tendencies are, of course, the inner drives of the general metabolic processes and of glandular secretions which must somehow condition the sensitivity of the organism to the several stimulating conditions of the external world. Many of the most careful and stimulating writers on learning, including Watson, who has put very great emphasis on mere frequency and recency factors, have explicitly recognized the importance in learning of certain inhibition and facilitation processes, as yet little known as to causal basis, of 'combination' processes, of the 'law of effect,' and so on; but usually the problem of accounting for them has been shifted or entirely avoided. Our contention here is that we must face these problems directly with no assumptions of spontaneous forces or faculties that, on general principles, have no place in science.

JOSEPH PETERSON

GEORGE PEABODY COLLEGE FOR TEACHERS